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# FAUNA OF THE U.S.S.R.

## TRICHOPTERA

## Volume II No. 1

S. G. Lepneva

## Larvae and Pupae of *Annulipalpia*

Translated from Russian

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# TRICHOPTERA

(Rucheiniki)

Volume II No.1

## S. G. Lepneva

## LARVAE AND PUPAE OF *ANNULIPALPIA*

(Lichinki i kukolki podotryada kol'chatoshchupikovykh)

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In memoriam
Andrei Vasil'evich Martynov

## *PREFACE*

Trichoptera develop as aquatic animals living on the bottom. They form a substantial part of the food resources of benthos-feeding fishes in many large water bodies, including important species of Salmonidae and Acipenseridae.

If we wish to preserve and improve water bodies inhabited by commercially valuable fish, many aspects of their life conditions have to be studied. This calls for a study of the systematic composition and biology of the food items, including the larvae and pupae of caddis flies. This is also necessary for fish farms, nursery ponds and fattening ponds, as it makes for an almost natural food supply.

Generally useful, Trichoptera can be harmful. If they occur in multitudes in large rivers in the plains, the caddis flies sometimes "flood" the surroundings as they take wing and may cause damage to the local population.

When hydropower stations are built, favorable biotopes for lithorheophilous animals such as caddis fly larvae are created on the compact concrete walls of the discharge channels; when the larvae pupate, they cover the walls of the channels with their cases, which consist of mineral particles; the cases form incrustations on the walls which grow thicker from year to year, reducing the channel profiles and thus impairing the efficiency of the power plants. It is necessary for control purposes to know to which species the harmful insects belong and to know their biology.

The present monograph gives a description of the morphology of the larvae and pupae of the Trichoptera of the USSR and of their biology and life conditions. The description is based on the systematics of the group and is accompanied with keys for identification.

The laboratory workers of the section on Neuroptera, E. A. Tetyueva and M. N. Kandybina, greatly assisted the author in the preparation of the present volume. Tetyueva proofread the long typescript and made a card index of the literature; she was also responsible for correspondence with libraries. The greater part of the bibliography was prepared by her. Kandybina
4 prepared many of the drawings as well as the plates for printing the drawings. I hereby convey my sincere gratitude to these two colleagues.

The painters of the Zoological Institute of the Academy of Sciences of the USSR (headed by T. F. Belotsvetova) made the illustrations to the present volume. I extend my thanks to all these, especially to N. L. Orshanskaya, who drew most of the figures from nature. The original drawings are not marked in the legends; the names of authors of drawings taken from other works are given in parentheses.

I am very grateful to the editor, Prof. A. Strelkov, who gave his constant attention to the present volume and supplied extremely valuable comments.

S. G. Lepneva

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### I. Family ***Rhyacophilidae*** Steph.

### Subfamily **Rhyacophilinae** Ulm.

### I. Genus **Rhyacophila** Pict.

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* [This index has been photographically reproduced from the Russian original. The pages indicated are Russian page numbers which appear in the left-hand margin of this text.]

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## LARVA

### General description

The structure of the larvae of Trichoptera is distinctly primitive. The body is very elongate; its division into head, thorax and abdomen is distinct; the thoracic and abdominal segments are not fused and are well separated. The mouth is directed forward or more or less downward; the mouthparts are of the biting type and are well developed. The prothorax is usually more strongly sclerotized than the two following segments. The legs are of the walking type; the hind legs are rarely swimming legs. The abdomen consists of nine segments; the ninth segment bears the anal legs. The integument of the abdomen is soft and membranous except for small sclerites and sclerotized points. All abdominal segments bear small tergites in some species of Hydroptilidae. The anal legs have a short stem with a thick terminal claw; they are characteristic for the order.

The larvae are 2–3 to 50–60mm long; the smallest larvae occur in the family Hydroptilidae, which includes dwarf forms; the largest larvae are characteristic for species of the genera Himalopsyche (Rhyacophilidae) Stenopsyche (Stenopsychidae), Phryganea (Phryganeidae), Dicosmoecus, Nemotaulius, Grammotaulius, Potamophylax, Hydatophylax (Limnophilidae).

The sclerites usually bear a pattern of stripes, spots and dots; the dots are pigmented or not pigmented points of the attachment of muscles to the inner wall of the sclerites; the outline of the dots may be distinct or diffuse. The pattern often varies in the species, but it is usually a reliable diagnostic character.

The hard and soft parts of the integument bear setae which often change markedly during metamorphosis and appendages of a different type. The number of primary setae on certain parts of the body is constant throughout the order; secondary setae occur in smaller or larger numbers in various groups. The chaetotaxy is an important diagnostic character of families, subfamilies and genera. The chaetotaxy of species varies sometimes to some extent.

The division of Trichoptera into two suborders is clearly marked morphologically and biologically in the larvae. The suborder Annulipalpia is characterized by campodeiform larvae* with a prognathous head, deep constrictions between the abdominal and thoracic segments, and usually with long anal legs which bear a claw that is diverted anteriorly and downward (Figure 1); the larvae are either free-living or they live in movable cases

---

* The name "campodeiform" indicates a resemblance to species of Campodea (order Thysanura).

10 shaped like shields or bags. Some of the free-living forms build fixed constructions in the form of long galleries, nets or chambers.

The suborder Integripalpia has eruciform larvae (Figure 2) with a hypognathous head,* fused abdominal segments separated by shallow constrictions; the anal legs are short, and the claws are directed laterally; they live in movable, tubular cases.

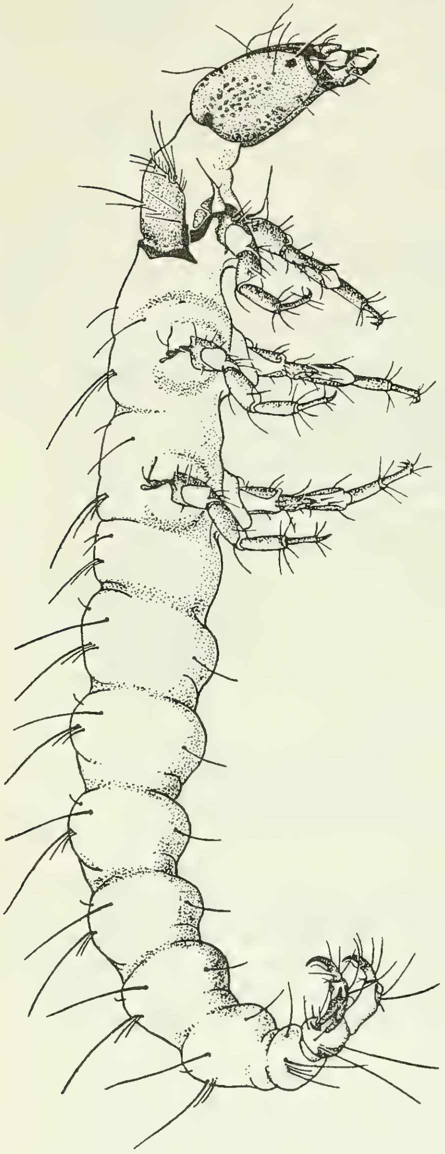

FIGURE 1. Campodeiform larva of Rhyacophila sibirica, lateral

To the same category belong larvae of a transitional type (suberuciform) with a slightly hypognathous head, deep constrictions between the segments of the abdomen, but with short anal legs as in typical eruciform larvae.

Caddis fly larvae undergo 4, rarely 5 or 6 molts; the total number of larval stages is usually 5, rarely 6 or 7; after completion of its development, the larva builds a pupal case or modifies and fastens the larval case; it spends a certain period in this case as a prepupa. It molts into the pupa inside the case.

Caddis fly larvae, except for a few genera (Enoicyla), live in the water. The larvae of some species live in springs or on the banks of water bodies with flowing or spring-water, among humid moss or humid 11 wood debris. The larvae live in very different water bodies, flowing or stagnant, fresh or brackish; they predominate in localities with a sufficiently humid climate and with a well-developed hydrographic network.

## External morphology

A description of the external morphology of the larva and pupa was given by a number of authors, e. g., Pictet (1834:29–100) (see Klapálek, 1888:1–23; Siltala, 1902:1–10, 33–38; 1905:34–38, 46–48; Ulmer, 1903:9–27, 1909:209–213, 283–285; Lestage, 1921:343–398; Orcutt, 1934; Lepneva, 1940:191–223). Nielsen (1942:259–318) described the external morphology of

---

* The hypognathism of the caddis fly larvae is not so sharply marked as in caterpillars of Lepidoptera.

12 the caddis fly larva and pupa, according to the principles of insect morphology established by Snodgrass (1935:1–279). A short survey of the external morphology of the larva and pupa of caddis flies was given in the book of Bertrand on aquatic insects (1954:16–42). Details of the morphology of some species and a few attempts of comparative descriptions of some structures are contained in the bibliography on pp. 174–180.

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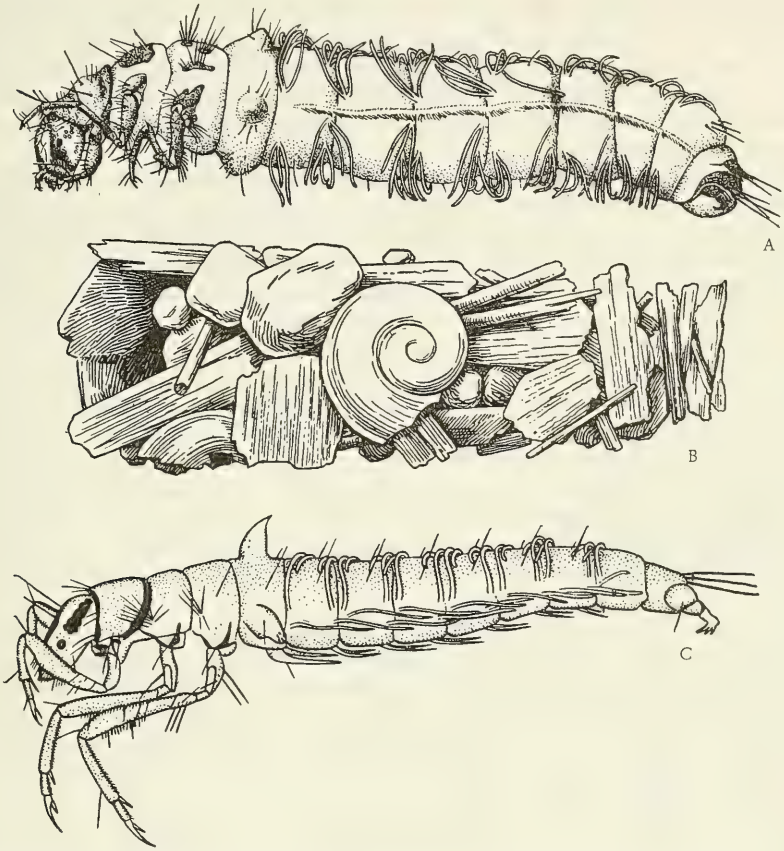

FIGURE 2. Eruciform larva of *Limnophilus flavicornis* (A) and its case (B); suberuciform larva of *Phryganea* sp. (C) (after Hickin)

**Cuticular appendages.** The integument, both its sclerotized and its membranous parts, bear appendages of two types, spines and setae (Siltala, 1907:356–365; Nielsen, 1942:263–267). Both types contain characteristic and well-differentiated elements, which differ morphologically and functionally;* spines are strongly sclerotized and have mainly a protective function (rarely filtering or cleaning); the setae are sense organs situated in depressions of the skin (alveoli) connected with a nerve cell at its base; the setae are connected with the cuticle by a thin annular membrane; the alveoli are surrounded by a thickened ridge which is sometimes dark. There are also pits resembling alveoli; these pits are also sense organs, but are without setae (Nielsen, 1942:265).

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* Drawings of spines and setae are given in the systematic part.

The spines vary in size and shape; they may be microscopical spinules, or they are larger, pointed or blunt, standing often close together or are fused at the base, forming combs or star-shaped groups; the larger spines may be short and thick or long, and spear-shaped, thin or thick; the thin and long spines and spinules are setiform and are named "hairlike spinules" or "hairlike chetoids"; they are usually referred to as hairs; the spines and spinules may be divided or branched, bifid, brushlike, stellate, featherlike or bushlike; the light hairlike chetoids on the ventral side of the trochanters and femora in a number of families are usually finely branched like a feather at the margins.

The setae differ markedly in size and form; the smallest and thinnest light setae are called setulae. The medium-sized and large setae are usually black, dark, medium or light brown, sometimes yellowish; some of them are light, hyaline, e. g., the anterior setae of the labrum, the lateral anterior-marginal seta of the frontoclypeal sclerite in a number of forms, or the ventral setae of the claw of the anal legs.

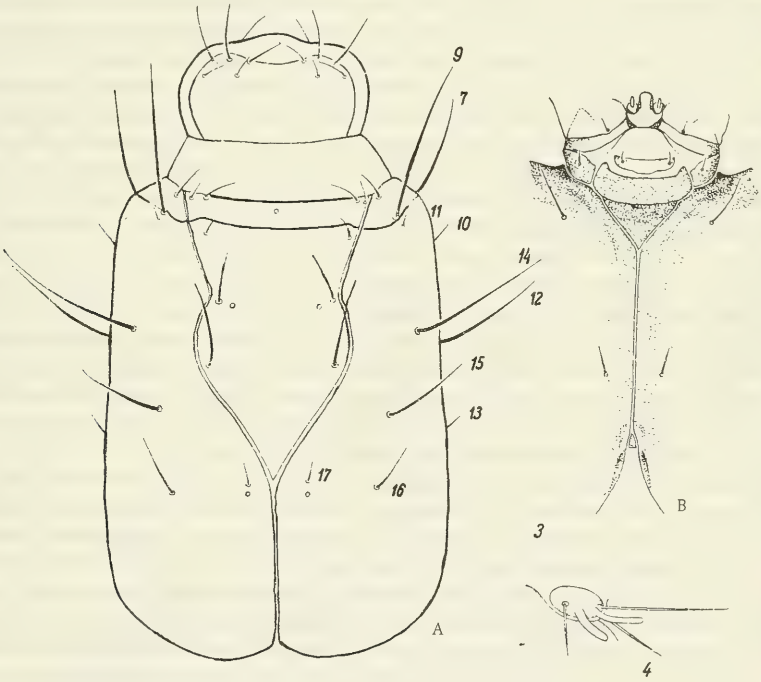
The setae present in the first stage larva are called primary setae; they retain this name in all later stages. The number of primary setae and pits is constant (Siltala, 1907:357–361; Nielsen, 1942:265). The setae which appear in the second and later stages are called secondary setae. The secondary setae of the second stage may reach almost the same size as the primary setae at the end of the second larval stage; they are rarely even
13 longer; the secondary setae of the later stages are usually shorter than those of the earlier stages; there are thus groups of setae of various size in the mature larvae, corresponding to the various stages. Secondary pits are not formed.

Secondary setae occur rarely on the head; they always appear on the pronotum; the setae of meso- and metathorax, legs and abdominal segments, in some families remain primary throughout all larval stages, but legs and nota of the thorax acquire a more or less rich secondary chaetotaxy in most groups; secondary setae do not appear on the ventral side of the thorax and on the claws. Secondary setae are also absent on the claws of the anal legs with rare exceptions (Beraeidae).

The development of secondary chaetotaxy varies markedly in different systematic groups; it is very small in primitive groups but well developed in highly specialized groups. The number of setae is given for only one side of the body in the descriptions.

**Head.** The head of caddis fly larvae is an elliptic capsule with a large occipital foramen and a narrower gnathal foramen. The cranium is divided into four well-defined sclerites (Figure 3) by the epicranial and hypocranial or gular sutures; these are the dorsal frontoclypeal sclerite, two lateral sclerites, and the ventral sclerite (gula). The anterior branches of the epicranial suture are called the frontal sutures (sutural frontales); they enclose the frontoclypeal sclerite, and separate it from the large lateral sclerite, the parietal sclerite; these sclerites form the greater part of the dorsal surface of the head, the whole lateral surface and the whole or greater part of the ventral surface. The lateral sclerites are contiguous, posterior to the frontoclypeus along the median epicranial suture, which is called the coronal suture; they are contiguous along the medioventral hypocranial (gular) suture. This suture extends from the occipital foramen to the gnathal foramen; in some species, however, its anterior part branches in most larvae into the gular sutures which enclose the gula. The gula extends in some species from the gnathal foramen to the occipital foramen, separating the lateral sclerites and gular sutures. The epicranial and hypocranial sutures form narrow membranous spaces between the sclerites;

In addition to the membranous sutures, there are also hard sutures which form rigid connections between the sclerites. On the frontoclypeus, these are the epistomal or clypeal suture, separating the frons from the clypeus. A more or less distinct suture separates a narrow plate at the anterior margin of the gula; this sclerite is the pregula, and is often fused with the gula. The subgenal suture is a continuation of the pistomal suture; it runs parallel to the gnathal foramen and delimits a narrow subgenal margin which constitutes, together with clypeus and pregula, the anterior thickened margin of the cranium with which the mouthparts are contiguous or articu-
14 lated: the labrum is attached to the clypeus, the mandibles and sclerites of the cardo are attached to the subgenal surface, and the middle of the submentum to the pregula. There is almost always a narrow ridge which forms the posterior margin of the cranium near the occipital foramen.



FIGURES 3 and 4

3 — head of Rhyacophila nubila, dorsal (A) and ventral (B); 4 — antenna of Wormaldia occipitalis (after Nielsen).

The frontal sclerite is fused with the clypeus, forming the frontoclypeus. The frontal sclerite forms an oblong posteriorly pointed plate in some families. There are two black spots approximately at the sides in the middle of their length; these spots (the tentorial pits) are depressions at the points where the anterior arms of the tentorium are attached to the cranium.* The position of the tentorial pits on the frontal sclerite is very constant; in most forms the sclerite is broader anterior and posterior to these pits, forming lateral notches in which the dark dots of the tentorial pits are situated. The whole sclerite is uniformly broad in the Hydropsychidae (Annulipalpia); the lateral notches are therefore absent and the tentorial pits are displaced inward from the margins of the sclerite.

The clypeus is a narrow transversely oblong plate, the posterior margin of which is fused with the frontal sclerite at the epistomal suture which corresponds approximately to the line connecting the base of the mandibles. The labrum is connected to the anterior margin of the clypeus by the flexible, distinct and narrow anteclypeus; this plate is partly sclerotized in some species. The anteclypeus is bent posteriorly by the muscles of the labrum, and can be retracted together with the labrum beneath the clypeus.

The anterior margin of the frontoclypeus bears 3 primary setae on each side (anterior-marginal setae):** the median, intermediate and lateral seta. The length of the anterior-marginal setae varies markedly; the lateral seta is often curved; it is light and bent above the surface of the anteclypeus. The anterior-, middle- and posterior primary frontal setae are situated one behind the other, at the sides of the frons, along the frontal sutures; the anterior frontal seta often resembles the lateral anterior marginal seta; it is situated in the middle of the anterior part of the sclerite; the middle frontal seta is situated near the tentorial pits, and is rarely displaced anteriorly; the posterior frontal seta is usually situated in the broadest part of the posterior part of the sclerite.

The anterodorsal region of the large lateral sclerites (parietalia) bears transparent protuberances on which the eyes are situated; the rudimentary antennae are situated anterior to them.

The eye consists of a small number of facets arranged in two rows; in the Philopotamidae, the anterior facets are situated at a distance from the posterior facets, so that the eye seems divided. The eyes are situated either near the margin of the head (species of Rhyacophila) or slightly removed from it; they are sometimes situated in the middle of the head or near it (Limnophilidae, Sericostomatidae).

The antennae (Figure 4) are situated in small pits surrounded by a ridge which is sometimes absent. They consist of one short segment which projects above the margin of the pit; this segment is sometimes reduced to a small soft tubercle with one or two, rarely three, sensillae and 1–3 setae at the apex which are sometimes absent. The antennae are in rare cases (Leptoceridae) almost as long as the mandibles, but they are usually much smaller, forming a small tubercle with a barely marked sensilla and a small seta. The antennae are situated anterior to the eyes, sometimes near the margin of the head.

The labrum (Figure 5) is connected with the membranous anteclypeus by a fold. The labrum is usually broader than long; the anterior corners of the labrum are rounded; the anterior margin of the labrum bears a small notch in the middle. The upper surface of the labrum is convex and sclerotized, the lower surface concave and soft; the dorsal sclerotization is either complete or incomplete, so that the anterior corners or the whole anterior margin are membranous; in the Philopotamidae the greater part of the dorsal surface of the labrum is soft and there is only a small sclerotized part in the middle near the base. The posterior corners of the dorsal sclerite of the labrum continue into narrow curved plates which extend ventrad and are called tormae.

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* Details of the tentorium are described below.

** Drawings of setae are given in the systematic part.

16 The labrum bears 6 primary setae: 3 lateral (1, 2, 3) and 3 on the surface (4, 5, 6) (Figure 5);* seta 1 is situated at the sides of the median notch; seta 3 is the longest of the marginal setae and is displaced toward the lateral part of the labrum; the position of seta 6 as shown in the figure is rather constant; seta 5 is usually longer than seta 6 and is situated lateral to seta 6. Setae 1, 2 and 4 often have the form of light spines; the sides of the dorsal sclerite bear 2 light pits which are not always distinct; there is a well-marked pit in the middle of the sclerite.** On the outer side anteriorly and ventrally, the membranous surface of the labrum is covered with soft, light hairs which are visible at the margin also in dorsal view.

The musculature of the labrum consists of small constrictions originating on the dorsal sclerite and inserted on its ventral wall. Two pairs of strong muscles, attached to the frontal sclerite, originate in the middle of the endolabium and on the tormae. In some predators among the Annulipalpia, the labrum may be retracted beneath the clypeus, enabling the mandibles which are projected far anteriorly to catch the prey.

The lateral sclerites of the cranium (Figure 3) bear 12 primary setae, mainly on the dorsal, partly also on the dorsolateral surface of the head; there are only 2 small ventral setae. There is a strong seta (No. 7) (after seta 6 of labrus) near the anterior margin of the head, near the dorsal articulation of the mandibles; this is usually longer than the intermediate and median anterior-marginal setae or almost as long as these. The large seta 9 is situated medially to the anterior margin of the eye; the small thin seta 11 is situated posteriorly to it. The small seta 10 is situated externally, near the anterior margin of the peri-ocular spot; the short or moderately long seta 12 is posterior and lateral to the eye. The large and stout seta 14, which is usually the longest seta of the head, is situated more medially; (this seta is rarely short;) among the above setae or near one of them is seta 13, which is small and thin and usually light; setae 15 and 16 are situated in the posterior part. They are situated close to each other or one behind the other; seta 16 is often short, curved inward, sometimes recumbent; in the suborder Integripalpia, seta 15 is often long, sometimes almost as long as seta 14; seta 17 is situated lateral to the bifurcation, in the corner between the coronal and frontal sutures; this is usually a small seta which sometimes (in some Hydroptilidae and in the Brachycentridae) is one of the longest setae of the head. Ventrally, near the lower articulation of the mandibles the short seta 8 is situated; the small seta 18 is situated on each side of the gular suture.

Differences in the form of the head are reflected in the distribution of the setae of the parietal sclerites. In larvae whose head is concealed under the overhanging anterior margin of the pronotum (while the eyes

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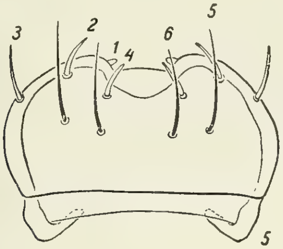
* The setae are numbered after Nielsen (1942:273–275, 278).

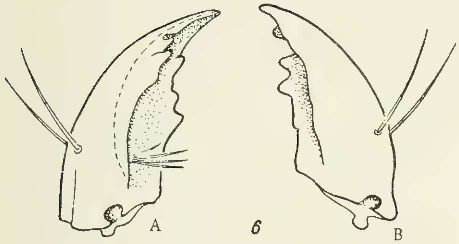
** There is never a seta in this always distinct pit, although such a seta was sometimes erroneously described; further details on such mistakes are found in Nielsen (1942:278).

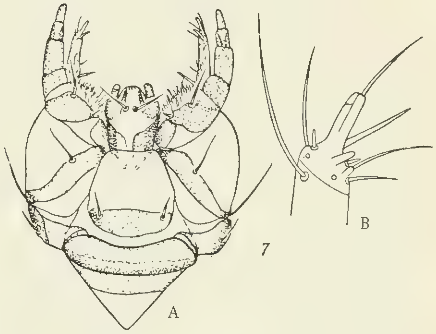
remain directed forward (e. g., in the genus Agapetus)) the setae of the middle and posterior areas are displaced toward the peri-ocular setae, forming one group together with them (see Figure 370). In larvae whose eyes are displaced far posteriorly (e. g., the genus Silo), some of the setae of the anterior part are displaced posteriorly together with the eyes, and only setae 7 and 8 retain their position at the base of the mandibles. In free-living larvae with a long prognathous head, the setae of the anterior
17 part of the head are well developed, while the setae of the posterior part are short (Rhyacophila, Wormaldia, Polycentropus). In case-bearing larvae with a hypognathous head, in which the dorsal process of the anterior margin overhangs the opening of the case, the setae of the anterior and posterior part are uniformly developed: seta 15 is thin, about as long as seta 14 (Limnophilidae); seta 17 is thick and one of the longest setae of the head (Brachycentridae).

The mouthparts of the larvae of caddis flies are of the biting type and are well developed; the movable labrum (Figure 5) covers the preoral cavity from above: the mandibles have a grasping function, bite the food and chew it; they break and form the material used for the building of the case; the maxillae and labium take part in the capture and retention of the food and pass it into the mouth through the preoral cavity; they also act as spinning organs. The mandibles are short, massive and strongly sclerotized the maxillae and labium are oblong, more or less soft structures which consist mainly of membranous integument which bears small sclerites. The differences in feeding methods and building activity results in marked morphological differences in the mouthparts.

The mandibles are of the biting or scraping type (Figure 6); they are short, massive, with a triangular base and irregular surface: the outer surface is curved, the ventral surface more or less flattened or convex and the dorsal surface concave; the distal end of the mandible is pointed. The mandibles are articulated with the parietal sclerites at the corners of the outer side of the base, by an acetabular-condylar articulation; the dorsal articular process bears an acetabular pit at the apex, the ventral articular process bears a condylar head which is connected with the mandible by a short neck; the situation is the opposite at the parts of the cranium articulating with the mandible: the condyle is situated dorsally and the acetabulum ventrally. The tendon of the strong adductor muscle originating at the posterior wall of the cranium and filling the greater part of its cavity is attached to the inner angle of the base of the mandible. The outer margin of the base of the mandible is always convex; the tendon of the abductor muscle originates at the apex of the arch. The inner concave margin of the mandible forms two cutting edges: the upper and lower blade (Figure 6); both blades are more or less equally developed in some predators (Polycentropodidae); in others, the upper blade is displaced toward the outer margin and forms a ridge (Hydropsychidae); the upper blade is sometimes reduced and the blades are flat and knifelike. The distal part of the upper and lower blade usually bears 2 or 3, rarely 1–4 pointed or blunt teeth; the tip of the mandible is pointed, and forms a long or blunt and broad tooth; there is a large basal masticatory tooth in some forms. The teeth of phytophagous forms are not situated on the blades but on the distal, broad margin of the mandibles. In forms living on epiphytic algae, the distal part of the mandible is without teeth, and the mandibles are spatulate, 18 forming a scraping tool. The distal, tooth-bearing part of the mandible is usually separated from the other part of the mandible by a transverse scar. The mandibles are always asymmetrical, and their blades are situated one above the other. The basal outer part bears 2 primary setae. In the concavity of the dorsal surface of the left, or of the left and right mandible is a tuft or row of hairlike spinules (penicillus) which is sometimes displaced toward the margin of the upper blade; the rows of small setae are sometimes present also on the outer-distal part of the blades.







FIGURES 5–7. Labrus, mandibles, and maxillolabium:

5 — labrus of Limnophilus rhombicus; 6 — mandibles of Plectrocnemia latissima, dorsal: left (A) and right (B); 7 — maxillolabium: Rhyacophila nubila, general view, ventral (A), Rh. septentrionis, end of galea (B — after Nielsen).

Maxillae and labium are so tightly fused that they represent a maxillolabium (Figure 7) which encloses the submentum, the mentum and the hypopharynx. The maxillolabium is contiguous with the ventral side of the gnathal foramen and forms the wall of the preoral cavity opposite to the labrum. The middle of the basal part of the maxillolabium forms the submentum which is contiguous with the pregula. The submentum is situated dorsally, inside the preoral cavity; it is membranous or contains thin, rodlike, lateral or transverse sclerites; ventrally, near the base or the middle of the submentum there is a typical, usually single sclerite; there is a seta on each side of the anterior margin of this sclerite; this sclerite may be single, paired or divided into three small plates. Deep, oblique or longitudinal grooves separate cardo and stipes from the submentum. The cardo, which is contiguous to the gnathal margin of the
19 cranium, is almost completely sclerotized on the ventral and lateral sides, and also partly on the dorsal side; in the larvae of Annulipalpia, this sclerite

bears one, in the Integripalpia usually 2 small primary setae on the outside. The stipes form the broad middle part of the maxilla; it bears an oblique narrow or well-developed ventrolateral sclerite with 2 primary setae, a shorter distal seta and a longer proximal external seta. Inside the preoral cavity, longitudinal grooves separate the submentum from the stipes of the maxilla; there is a tubercle covered with thin hairs near the distal margin of the stipes in many forms which is developed in some species of Halesus and Silo into a distinct lacinia with a small basal sclerite (Nielsen, 1942:285); the lacinia is absent in many forms, even as a rudimentary tubercle.

The distal part of the stipes reaches the palpifer with the galea and four-segmented palp. The palpifer bears two sclerites: a lateral sclerite which extends ventrally, externally and partly dorsally, and a small medial sclerite; the lateral sclerite bears 2 setae, one at the anterior margin and one at the inner margin which is much smaller than the anterior seta.

The galea of predators (Rhyacophilinae, Polycentropodidae) is completely sclerotized and cylindrical with a membranous distal margin; the galea is short in a number of forms and in others (Agapetus, Apatania, Silo) it is reduced to a small tubercle. The galea bears setae and sensillae (Figure 7, B); Annulipalpia have 7 setae with the numbers 3–9 (following setae 1–2 of the palpifer); the galea of Integripalpia bears 4 setae, numbered 6 to 9 (the palpifer of this suborder bears setae 1–5); setae of the galea are often lost; there are 3 pairs of sensillae numbered I–III. In addition to the above sensillae and setae which are constant for the order, palpifer, galea and lacinia of a number of groups are recovered with numerous thin hairlike setae.

The palp consists of four segments with crescent-shaped or annular sclerites; these sclerites bear one or two minute light pits; the palps may be long or very short; the tip of the terminal segment is membranous and bears sensillae.

The labium (Figure 7) consists of the second, fused pair of maxillae; it forms the labial lobe[*] together with the mentum. The labial lobe forms a more or less long ligula. The mental sclerite surrounds this part ventrally, laterally and partly (sometimes completely) dorsally in some forms; the mental sclerite is divided into two halves in some groups by the membranous ventral suture. On the labial part proper, two small, rodlike sclerites, each of which bears a small seta are situated distal to the mentum; these sclerites are called the ventral sclerites or the ventral rods. At the
20 base of the labial palps are the small sickle-shaped sclerites of the labial palpiger; each sclerite bears a pit. The labial palp consists of one segment with three terminal sensillae; it is sometimes very small, rudimentary and sometimes absent (Psychomyiidae).

**Thorax.** Prothorax, mesothorax and metathorax of the larvae of caddis flies are always distinctly differentiated and more or less sclerotized. There are sclerites of two types on the dorsum:[**] large sclerites (nota or terga)[†] which occupy the whole dorsum or most of it, and small tergites in

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[*] The distal part of the organ, without the mentum, may be called the labial lobe proper (eulabium), while the more basally located medial area of the gula-mentum may be considered as consisting of the gula, pregula, submentum and mentum.

[**] We distinguish between the prodorsum, mesodorsum and metadorsum.

[†] We distinguish between the pronotum, mesonotum and metanotum, which are the sclerites of the prodorsum, mesodorsum and metadorsum.

addition to the large sclerites or replacing them. The large dorsal sclerites usually consist of two halves separated by a median longitudinal suture;* there is rarely a transverse suture which divides each sclerite into an anterior and posterior part. The sclerotization of the thorax differs in the various families. In four families of Annulipalpia the nota of all three thoracic segments bear almost equally developed sclerites; in the other families of this suborder, only the pronotum is completely sclerotized, while the mesonotum and metanotum are not sclerotized (Figure 1) or, as in the Agapetinae, bear only small paired tergites. In species of Integripalpia living in tubular cases, the dorsal sclerotization of the thorax decreases posteriorly. When the larva moves, the prothorax projects completely from the case; it possesses a well-developed pronotum; a large mesonotum is also present in the larvae of Integripalpia except in the Phryganeidae, but it is not as well developed as the pronotum; in the Leptoceridae, Molannidae and some other families the mesonotum covers only part of the mesothorax, and part of the mesothorax is membranous; in families of Integripalpia in which the metanotum is sclerotized, the sclerotization consists of various arrangements of small tergites (Figure 2).

The form of the pronotum (Figure 8) varies markedly in the different families. The anterior angles of the pronotum may be rounded or rectangular; in other cases they have pointed, anterior processes (Goeridae). The pronotum is always more or less convex; the anterior third of the pronotum is separated from its other part by a transverse groove in some groups; a deeper groove separates the often thick posterior margin and partly the lateral margin; the ridge of the lateral margin forms processes which articulate with the sclerites of the pleural region. The posterior angle of the pronotum forms a lobe which is sometimes so long that it extends to the lateral and ventral surface and is even, sometimes fused in the middle of the ventral surface with the lobe of the opposite side, so that the pronotum is closed. The anterior margin of the pronotum continues into a thick, sometimes slightly sclerotized membrane connecting the prothorax with the head; this membrane is folded under the anterior margin of the pronotum which sometimes projects to such an extent that the head may be deeply retracted beneath the pronotum.

21 The mesonotum (Figure 9) is less convex than the pronotum; it is almost flat in forms in which it is incompletely developed; its posterior margin is thickened.

If tergites are present on the metathorax they are of very diverse form.

The nota of each of the three thoracic segments bear 5 pairs of primary setae (Nielsen, 1942:298); each half of the notum bears one seta on the anterior angle, one on the anterior margin and 3 on the surface (a medial, intermediate and lateral seta). This arrangement is well marked also on the unsclerotized segments of Annulipalpia. This arrangement is usually disturbed on the pronotum: the seta of the anterior margin is displaced toward the surface setae, or the surface setae (especially the lateral setae) are displaced toward the anterior margin of the pronotum; there are secondary setae which are present in small numbers on the pronotum even if the primary chaetotaxy is retained on the other thoracic and abdominal segments during all larval stages; the secondary setae of the anterior corner of the segment are especially constant; there may be one, two or more.

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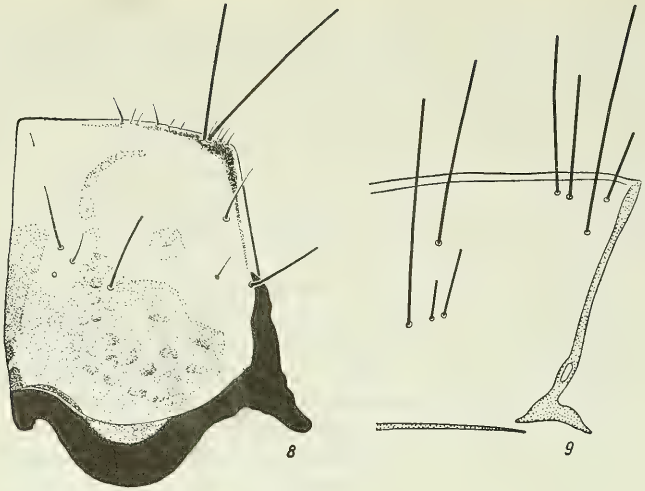
* The medial suture is absent in the first larval stage.



FIGURES 8 and 9. Nota:

8 — pronotum of Rhyacophila obliterata (after Kachalova); 9 — mesonotum of Ecnomus tenellus.

The secondary chaetotaxy is often very rich and makes the above-described arrangement less clear; the primary setae are usually distinguished by their greater thickness and length.

The pleural region of the thoracic segments forms pillarlike or irregular,
ventrally directed, short processes to which the legs are attached. The
following sclerites of the pleural region serve for the articulation of the legs:
22 episternum, epimeron and trochantin, which are together called the pleuron.*
The primary chaetotaxy of the pleuron consists of one seta on the epimeron,
situated on the sclerite or close to it on the membrane, and of one seta or
2 setules on the trochantin; the episternum does not bear a primary seta.
The trochantin of the prothorax is of a different form and bears a distal
process; in some genera of Aethaloptera this process is very long. The
trochantin of the meso- and metathorax forms a small plate which is usually
fused with the episternum and is rarely free; the primary seta of the fused
trochantin is situated on the boundary with the episternum and is often
arbitrarily named (also in the present book) the seta of the episternum; the
trochantin of both the meso- and metathorax is rarely free.

A ventral sclerotization of the thorax of some groups (Rhyacophilinae) is completely absent; in a number of groups of Annulipalpia (Glossosomatidae, Hydropsychidae) the prosternum is well developed, and covers the ventral surface of the segment completely or almost completely; in the Hydroptilidae, all three thoracic segments bear median sternal sclerites;

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* The name "supporting plate" (in German "Stützplättchen" and in French "plaque d'appui") was widely used in keys and in the literature in the past for the sclerites of the pleural region. This name is not used any more. Lloyd (1921:9, 11) states that "the 'supporting plate' of the larvae of caddis flies is the episternum and epimeron." The literature of the 1930's on the comparative morphology of insects classified this point (Snodgrass, 1935:161—166); for information on the morphology of the thorax of larvae of caddis flies, see Nielsen, 1942:292—296. A list of the old and new terms used in the description of the larvae of caddis flies has been given by Lepneva (1949:162).

the prothorax of some Integripalpia (Limnophilinae) bears a small medial sternite with small plates or rows of dots at the sides; similar (sometimes indistinct) dots are present on the ventral side of the meso- and metathorax.

**Legs.*** Caddis fly larvae living on the bottom of water bodies have legs of the walking type. The forelegs are adapted for catching the prey or for other functions connected with the collection of food or the construction of the case, and are usually shorter than the mid- and hind legs. The hind legs are sometimes especially long. The hind legs are natatorial in some species of Leptoceridae (Triaenodes). In the same family and some other families (species of Beraea, Sericostoma) the long hind legs have a tactile function, as they are first extended from the case when the larva emerges from it. In larvae with a heavy mineral case (Molannidae) which move forward in leaps, the short forelegs have a supporting function when the larva rests on the substrate during leaps.

The legs (Figure 10) consist of six segments: coxa, trochanter, femur, tibia, tarsus and pretarsus.

(23)

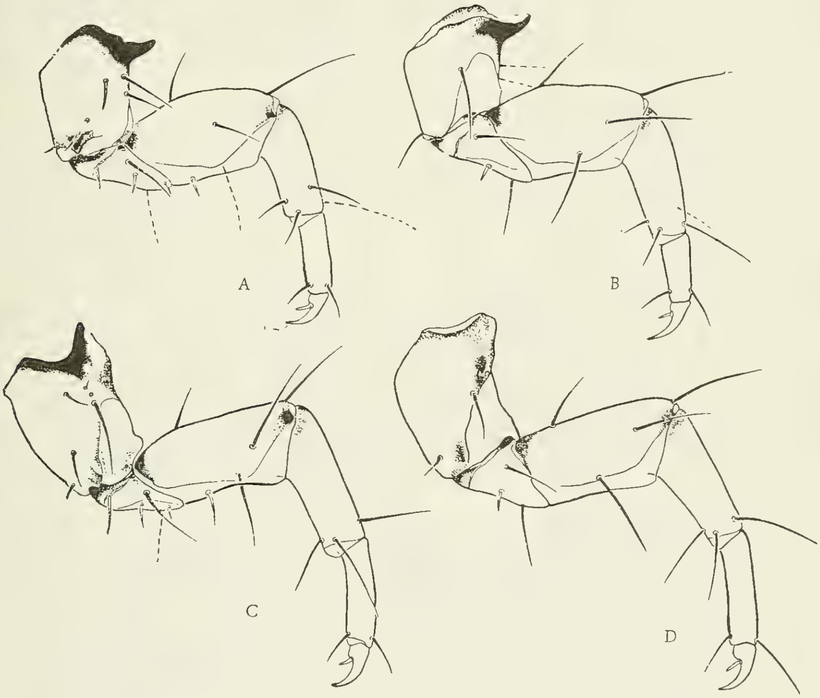

FIGURE 10. Legs of Rhyacophila nubila:

foreleg, anterior (A), posterior (B); hind leg, anterior (C), posterior (D).

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* Snodgrass (1935:193) suggested a method of orientation of the leg for descriptions. The leg is considered extended at a right angle to the body. In this position the preaxial part of the leg is the anterior part, the postaxial the posterior part, the outer surface is the dorsal and the inner the ventral surface.

The coxa is massive and articulated with the pleural sclerite. It contains a very large muscle and the base of the coxa is therefore always markedly thickened. The dorsal surface of the basal part of the coxal sclerite is concave. It is deeply notched in the distal part, and there is a large membranous area; this notch encloses the dorsal margin of the femur when
23 the femur is moved laterally. The coxal sclerite is very strong because of the thickening of its basal margin which forms a massive dark rim, connected at the inside by a fold of the sclerite. The basal margin of the coxa has an articular process dorsally, which enters into the cavity on the inner side of the episternum, to which it is attached by skeletal fibers; the apex of the articular process of the basicoxite of the foreleg is wedged into the corner formed by the trochantin and episternum. This articulation ensures freedom of movement of the leg, especially for the complicated movements during the building of the case.

The coxa articulates with the trochanter at two points at the sides of the ventrodistal margin of the coxa. The coxa bears 7 primary setae: 3 dorsal setae (2 anterior and one posterior to the groove), 2 anterior surface setae and 2 ventrodistal setae; one of the 2 anterodorsal setae is situated basally (basodorsal seta) and the second one is situated near the apex of the dorsodistal depression; the dorsal setae may be very long;
24 the setae are usually short, slightly marked, rarely long; they are divided at the end in some groups; the ventrodistal setae are either short or long; one seta is longer than the other.

The trochanter is situated between coxa and femur; it articulates with the coxa at one end and with the femur at the other; the dorsal short side of the trochanter bears in some cases only a narrow transverse hard sclerotized band or is not sclerotized at all, so that the sclerite is dorsally membranous. The trochanter is divided into a short basal part and a larger distal part by a suture near its basal margin; this suture is incomplete and interrupted ventrally. The basal margin of the sclerite bears two articular processes for its connection with the coxa; the trochanter is contiguous with the femur at its distal margin; in some forms (species of Rhyacophila) trochanter and femur are only partially contiguous anteriorly, and a small membranous part is present; posteriorly, the distal margin of the trochanter is displaced to the basal margin of the femur and is tightly connected with it, so that femur and trochanter act functionally as one segment. The above form of the trochanter is mainly characteristic for the forelegs; it is also characteristic for the middle and hind legs in many groups. In some families (Limnophilidae, Leptoceridae) the trochanter is oblong, curved, with a distinct dorsal surface or forms a straight rodlike structure. The trochanter bears 7 primary setae: 2 surface and 5 ventral setae; both the surface setae (anterior and posterior seta) are situated apically or subapically; of the 5 ventral setae (distal and subdistal) 2 are situated posteriorly, and 3 anteriorly (one long seta is situated basoventrally near the suture and 2 usually spinelike setae are situated apically and subapically); several ventral setae of the distal section of the trochanter of the middle and hind legs are very long.

The dorsal surface of the femur is longer than its ventral surface; the femur has a deep ventrodistal depression in which the tibia is situated when the leg is folded; the femur is ventrally membranous in some groups

(Rhyacophila). The lateral margins of the femur bear two inward directed pointed tubercles dorsodistally: the posterior tubercle forms the tibiofemoral articulation, entering into the pit of the basal margin of the tibia. The femur bears 6 primary setae: 2 dorsal (one basal and one distal); the latter is situated slightly posteriorly; 2 ventral setae in a row (at some distance from each other); 2 surface setae (an anterior and a posterior seta) which are usually situated apically or subapically. The primary setae of the femur may be long.

The tibia is straight or slightly curved and is usually shorter and narrower than the femur; however, the tibia may be as long as the femur or longer, e. g., in the hind legs of Beraeidae, some Leptoceridae and Sericostomatidae. The convex rib of the dorsodistal margin of the tibia enters into the groove at the basal margin of the tarsus, however, the angle between tibia and tarsus is very small. The tibia bears 6 primary setae, 2 dorsal, 2 ventral and one anterior and one posterior seta; all setae of the tibia are concentrated in its distal part, often near the distal margin of the leg; the anterior and posterior setae are usually displaced toward the dorsal setae, rarely toward the ventral setae, or one is displaced toward the dorsal setae and the other toward the ventral setae; the dorsal setae are usually situated apically or subapically, but they are sometimes more or less displaced from the margin.

The tarsus is narrower and shorter than the tibia; its articulation with the claw resembles that between tibia and tarsus. The tarsus bears 4 primary setae apically or subapically; the setae are usually arranged in pairs, 2 dorsally and 2 ventrally or subventrally; the ventral setae are far from the dorsal ones but are rarely situated close to them (hind legs of Beraea, Sericostoma).

The claws are curved and pointed; the claws of first-instar larvae are slightly curved, those of full-grown larvae strongly or slightly curved; the claw is thickened; there is one primary seta basoventrally, usually in the form of a short and thick spine.

The length and shape of the primary setae of the legs of the caddis fly larvae vary markedly; some setae may be very short and thick, forming spines. Secondary setae (if present) may develop on all segments of the legs except on the pretarsus; they are often present in large numbers and are markedly differentiated.

The **abdomen** is long, consisting of nine soft, membranous, weakly sclerotized segments. The constrictions between the segments are always distinct. In the free-living, very mobile larvae of Annulipalpia, the abdomen is usually slightly flattened and the constrictions between the segments are deep; this is also the case to some extent in the suberuciform larvae of Phryganeidae and Molannidae with tubular cases; in the typical eruciform larvae of the other Integripalpia, the abdomen is almost cylindrical and the intersegmental constrictions are shallow; in some groups (genus Leptocerus, all Apataniinae, Goeridae, Brachycentridae) the abdomen is short; it is laterally compressed in Hydroptilidae (Annulipalpia).

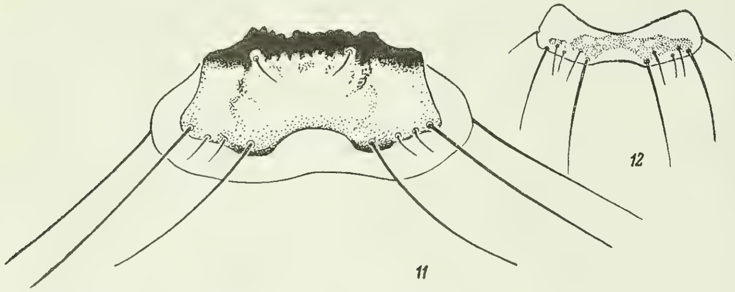
In larvae inhabiting tubes (Integripalpia) the first abdominal segment bears short, papilliform, thin-walled tubercles dorsally and on the sides; when the larva presses against the wall of the case, these tubercles enable it to perform undulating movements which create a current inside the tube.

The dorsal tubercle is larger than the lateral ones and is often pointed; the lateral tubercles are blunt. The apex of the tubercles is retractile, forming a longitudinal fold in the case of the dorsal tubercle or a transverse fold in the case of the lateral tubercles. In the Limnophilidae, also the ventral surface of the 1st abdominal segment often bears a ridgelike tubercle. In larvae of Integripalpia living in tubes, the pleural region of the abdomen bears a so-called lateral line which is a fine fold covered with short hairs; the function of this line is to increase the water current in the tube when the abdomen makes undulating movements.

The 9th segment is narrower than the others; it bears the slitlike anus posteriorly; the sides of this segment bear the short posterior or anal legs (postpedes) which end in claws.

The sclerotization of the abdominal segments is little developed, in the form of small sclerites and sclerotized dots; it is usually present only on the anterior and posterior parts of the abdomen. In a number of families of Annulipalpia (Philopotamidae, Stenopsychidae, Psychomyiidae, Ecnomidae, 26 Polycentropodidae) the abdomen of the larva is not sclerotized at all;* in Rhyacophilidae, Glossosomatidae and Hydroptilidae the sclerite of segment 9 covers almost the whole dorsum of the segment; in the Hydroptilidae, small tergites are often present also on the other abdominal segments; these sclerites are distinct; they are also well marked in larvae of Stactobia, young larvae of Agraylea, and larvae of the American species of Leucotrichia (Ross, 1944:120, Figure 449), in the larvae of the genera Plethus and Lamonganotrichia (related to Stactobia) described by Ulmer from the Sunda Islands, and in some other forms (Ulmer, 1957:180, 195, 202–203, Figures 94–99, 114–118). Nielsen described small (almost rudimentary) tergites on young larvae of Hydroptila and Oxyethira (Nielsen, 1948:94, 92). In the Integripalpia, the sclerotization of the 1st abdominal segment (Limnophilidae) consists of small sclerites or dots near the dorsal and lateral tubercles, and on the ventral ridge which sometimes bears a well-marked sternite in the middle. In the Molannidae and some Limnophilidae, there are small sclerotized dots instead of the lateral line or near it. The dorsal sclerite of segment 9 (if present) is variously developed, covering the dorsal surface of the segment completely or nearly completely, or occupying only a small part of it (Figures 11 and 12).

(27)



FIGURES 11 and 12. Dorsal sclerite of the 9th segment:

11 – Rhyacophila subovata; 12 – Odontocerum albicorne.

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* Except the anal legs which are described below.

The number of primary setae on the abdominal segments is the same as on the thorax, but their arrangement and shape are different; the abdominal setae, especially in case-bearing larvae, are much shorter than the thoracic setae. Of the 5 dorsal setae* of the abdominal segments, the seta in the anterior corner is markedly displaced posteriorly (it retains this designation as it is homologous to the corresponding seta of the thoracic segment); in a number of forms the seta at the anterior margin is much reduced in size and thin, sometimes only a hardly noticeable setule; the same is often the case with the intermediate and lateral surface setae which are much shorter than the anal seta at the base of which they are situated.

The seta in the anterior angle and all 3 surface setae on the dorsum of segment 9 are displaced posteriorly and arranged in a row; if a tergite is present, it is situated at the posterior margin; the seta at the anterior margin either remains in its place in the form of a setule, or is also displaced toward the surface setae, slightly anterior to them (Figures 11 and 12). In the pleural region, 2 small setae are arranged in a row, one behind the other. Ventrally, there are 3 setae on each side; on segments 2–7 these small setae form a transverse row in which the median seta is longer than the other two; there are 3 setae on segment 9 and the lateral seta may be displaced to the pleural or even dorsopleural region.**

**Anal legs.** The posterior margin of abdominal segment 9 bears the anal legs (postpedes), or claspers.† The anal legs differ in shape, according to the mode of life and movement of the larva. In free-living larvae, the anal legs are long, flexible, with the structure of walking legs; the larva uses them to support the posterior end of the soft body. Eruciform larvae living
27 in cases use the thoracic legs for movement, while the anal legs are only for holding the case and for movement inside the case; the anal legs of such forms have the form of short crotchets and deserve the name claspers.

In spite of the differences in the appearance of this highly specialized organ caused by its adaptation to different tasks and mode of movement, the anal legs of the caddis fly larvae are built according to the same plan in the whole order.

The main part of the anal leg consists of a basal part ("a"), a medial part ("b") and an apical part ("c")†† (Figure 13); part "a" is present in the long anal legs of the larvae of Annulipalpia (except Rhyacophilidae, Glossosomatidae and Hydroptilidae); it is always soft, not sclerotized, and in some groups divided by a fold into two parts by a transverse skin fold; part "b" bears a long dorsolateral sclerite; the claw of the leg is movably attached in two points at the distal end of the sclerite; part "b" bears 4 primary setae; the sclerite of part "c" has a ventrodistal position; it usually bears one seta, rarely two.

The claw has a basal margin with two dorsal articular processes and a ventral process to which the adductor muscle is attached. It is divided into a basal part and the claw by a membrane; this membranous groove extends

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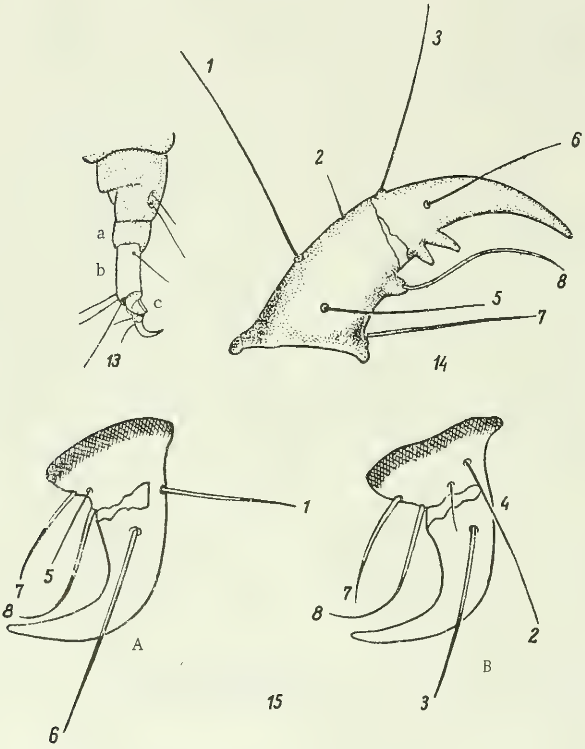
[*] Only the setae of one half of the segment are described.

[**] In addition to the primary setae, the abdominal segments bear one or two presegmental setules dorsally (Nielsen, 1942:300).

[†] The anal legs are paired appendages of the 9th segment; they are present already in the embryo; Krafka's opinion (1924:99–102) that the basal part of the legs consists of the divided 10th segment was refuted by Nielsen (1942:309).

[††] These parts are marked with Latin letters from comparative morphological studies (Nielsen, 1942:306–311).

to the lateral and ventral sides of the claw, but does not extend to the dorsal
side; on the dorsal surface of the distal part of the claw of some forms
there are one or two small claws (sometimes there are more than two);
the ventral surface sometimes bears one or several spinules; the fully
sclerotized, blunt or pointed part of the claw begins at this part. The claw
bears 8 setae. The following arrangement of setae is present in most
families (Figures 14 and 15): seta 1 is situated subdorsally, slightly medial*
in the basal part; seta 2 is situated opposite the groove or slightly more
basally; seta 3 is situated in the distal part, subdorsally; seta 6 is situated
28 on the outside; setae 7 and 8 are situated ventrally, in the basal part; seta 5
is situated near seta 8 or subventrally (on the outer side); seta 4 is situated
more medially.



FIGURES 13–15. Anal legs:

13 – anal legs of Wormaldia occipitalis, lateral, parts "a", "b" and "c" and claw (after Nielsen); 14 – Rhyacophila obliterata, outer side of claw (after Kachalova); 15 – Hydropsyche angustipennis, claw, outer side (A) and inner side (B).

The anal legs of the larvae are an important organ which bears a great mechanical load; they are very variable, adapted to different methods and conditions of movements in different groups. The claws also vary accordingly; they may be large or small, long and narrow, laterally compressed or short, and expanded at the base. The curvature of the claw and the breadth of its membranous part are also very variable; the arrangement and relative length of the setae of the claw also vary; some of them increase, others decrease in size, becoming thin and hardly noticeable; The anal legs of the larvae of some species of Rhyacophila are an example of complex structure; part "a" is absent (Figure 193), and the massive and broad 29 part "b" occupies the larger part of the leg; the large dorsolateral sclerite of this part bears a thick black ventral hook on the outer side, near the base; near the hook is a small ventral plate bearing a seta (this plate is separated from the sclerite); there is an upward directed, blunt tubercle dorsodistally at the base of which are pits articulating with the claw on each side; on the outer side is a long posteriorly directed, sword-shaped lateral process. Part "c" bears two small sclerites with a small seta on the smaller sclerite. The ventral side of the curved claw with its large basal part bears three tubercles near its suture; one in the basal part and two in the apical part. Seta 3 is displaced to the dorsal side; the ventral setae 7 and 8 are curved, light-colored and relatively thick.

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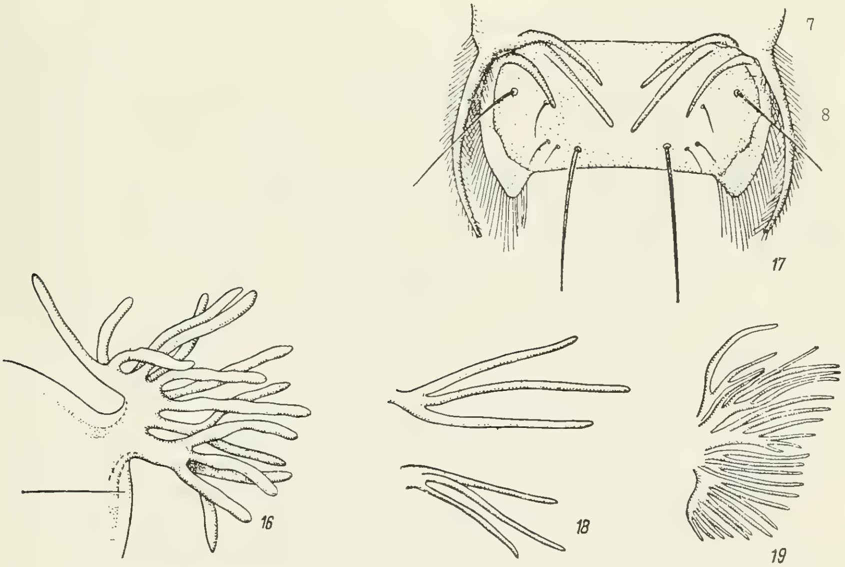
* The side of the anal legs directed toward the median axis of the larva.

**Tracheal gills.** The tracheal gills of the larvae of caddis flies are outgrowths of the integument with a tracheal trunk inside the body; this trunk is branched toward the surface of the gill, and each cell of the respiratory epithelium of the gill is surrounded by tracheoles.



FIGURES 16–19. Tracheal gills:

16 – Rhyacophila nubila; 17 – Phryganea striata, segments 7 and 8; 18 – Limnophilus rhombicus; 19 – Odontocerum albicorne (after Nielsen).

In the suborder Annulipalpia (which has campodeiform larvae) the larvae of most families have no gills; the larvae of several genera of the family Hydroptilidae have isolated filiform gills at the end of the body; the larvae of some species of the subfamily Rhyacophilinae and of the families Arctopsychidae and Hydropsychidae have a rich and complex gill apparatus consisting of pectinate, bushlike or tufted forms of simple segmented or branched tracheal gills (Figure 16). In the suborder Integripalpia with eruciform larvae living in portable cases, all species (with a few exceptions) have tracheal gills during the later instars; these tracheal gills consist of 1–3, rarely 4, filaments; in some groups (family Odontoceridae, genera Leptocerus, Ironoquia, Brachycentrus) and in the Integripalpia there are tufted gills (Figures 17–19).

The abdomen and the two posterior not sclerotized segments of the thorax bear a light pattern of stripes, lines, spots and dots, formed by areas with a thin integument without pigment. During the life of the larva, these parts of the integument are intensely stained with silver nitrate and are the places at which oxygen is absorbed by cutaneous respiration. Krawany therefore called these regions (1935:245) "respiratory fields." The great physiological importance of cutaneous respiration of the caddis fly larvae may be explained by the disproportion between the oxygen needs of the larva and its ability to satisfy it by the tracheal system. This disproportion is especially marked in large larvae living in cases.

## Anatomy

Most authors who studied larvae of Trichoptera described only their external morphology; the internal organs were insufficiently studied, and only in a few species. The first, already obsolete description of the anatomy of Trichoptera (including larvae and pupae) was given by Pictet (1834:62–105); a similar description was given by Klapálek (1888:5–8). In his description of the larva of Molanna cinerea, Betten (1902) also described its internal anatomy; Martynov (1903) studied the peritrophic membrane of the larvae of Agrypnia varia, Phryganea striata and Triaenodes bicolor; Vorhies (1905:108–118) described the anatomy of the larva of Platyphylax designatus; Lübben (1907) studied the intestine, the tracheal and the nervous system, the blood gills and genitalia of a number of species of the genera Rhyacophila, Philopotamus, Plectrocnemia, Limnophilus and Brachycentrus, and described the changes in these organs during metamorphosis; Russ (1908) studied the intestine of the larva of Anabolia furcata. Noyes (1915) described the proventriculus of the larva of Hydropsyche; Branch (1922) described the anatomy of the larvae of Hydropsychodes analis, Phryganea interrupta and Limnophilus indivisus; Brocher (1923) drew attention to the prosternal horn of Phryganeidae and Limnophilidae and its physiological function; Glasgow (1936) gave an anatomical description of the larva of Hydropsyche colonica. Ahmad (1949) described the mouthparts, the cephalic glands and the intestine of the larva of Hydropsyche sp.; Haller (1948) described the histology of the digestive organs of the larva of Hydropsyche; Racieçka (1949) gave a detailed anatomical-histological

description of the nervous system of the head appendages, and of the legs and anal legs of *Molanna angustata*. Novak (1952) studied species of 21 genera and 4 families of the Annulipalpia (Rhyacophilidae, Philopotamidae, Polycentropodidae and Hydropsychidae) and six Integripalpia (Phryganeidae, Molannidae, Leptoceridae, Odontoceridae, Limnophilidae and Sericostomatidae), and described the topographical anatomy of the tracheal system of the larvae; Winkler (1959) studied the musculature of the larva of *Limnophilus flavicornis*, and gave good drawings of the muscles of head, thorax, legs, abdomen and some internal
31 organs; some of these drawings are reproduced here. Satija published a number of papers (1959a–1959c; Satija, 1959, 1960) on the structure of the mouthparts and intestine of the larvae of caddis flies in connection with the feeding habits of some species.

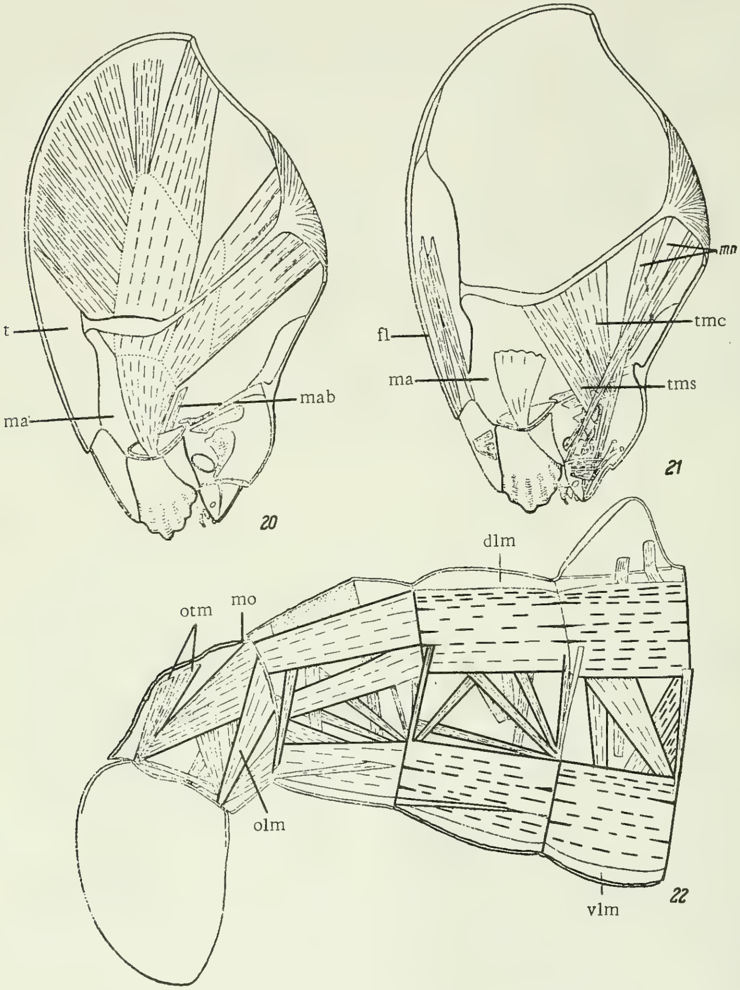
In spite of the large number of publications and detailed studies of some systems of organs, like those of Racieçka, Novák and Winkler, the following description of the anatomy of the internal organs of the larvae is not complete. The data given refer to full-grown larvae.

**Musculature.** The greater part of the head capsule is filled with the muscles which activate the mandibles; the large adductor of the mandible (musculus craniomandibularis internus) is the largest muscle of the head, attached by a strong, partly sclerotized ligament to the inner process of the triangle at the base of the mandible; this muscle is divided into two branches (Figure 20) at about the level of the tentorium; it consists of an upper and lower branch; the upper branch is divided into several bundles which are attached to the dorsal wall of the posterior part of the head capsule near the epicranial suture and the occipital foramen; the second branch is attached near the ventral side of the occipital foramen. The traces of the attachment of the muscles are visible on the head as rows and groups of large dots, the situation of which is constant in spite of the considerable variation in size, coloration, their relative position to each other, and other secondary characters. The labrum (Figure 21) is moved by one muscle (musculus frontolabralis) and two paired muscles on the sides, which originate on the frons. Relatively large muscles, moving the maxillolabium (m. tentoriocardinalis and m. tentoriostipitalis) are attached to the tentorium (Figure 22); smaller muscles connected with the mentum and other parts of the maxillolabium are shown in Figure 22.

The anterior part of the intestine inside the head is connected with the dorsal and ventral wall of the head by thin muscles at some points.

The thoracic segments and abdominal segments 1–9 and their musculature are illustrated in Figures 22 and 23–26. The strong muscle extending from the posterior margin of the prothorax to the dorsal margin of the occipital foramen retracts the head beneath the pronotum; several muscles, including the relatively large dorsal muscle of the pronotum (m. pronoto-postoccipitalis medialis) and the lateral muscle attached to the ventral margin of the occipital foramen move the head laterally and bend it downward. The strong basocoxal muscle extends from the posterolateral part of the pronotum to the coxa of the foreleg, moving the forelegs. Dorsally, along the thoracic segments from one segment to another and along the abdomen runs a broad dorsal longitudinal muscle; a similar longitudinal muscle is present on the ventral side; the above muscles effect longitudinal contraction of the body; when they work separately, they bend the body; they sometimes curve the abdomen ventrally and straighten it dorsally. The first abdominal segment contains two small muscles on each side, acting as retractors of the dorsal tubercle of the segment.

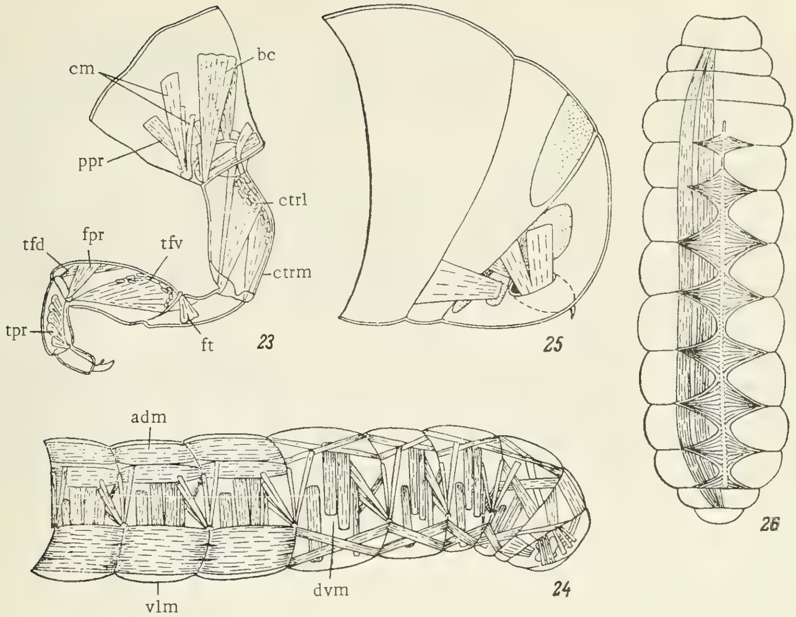
(32)



FIGURES 20–22. Musculature of the larva of Limnophilus flavicornis (after Winkler):

20 – adductor of the mandible and its branches; 21 – muscles of labrum and maxillolabium; 22 – muscles of the thorax and first abdominal segment.

ma – mandibular adductor, vlm – ventral longitudinal muscle, dlm – dorsal longitudinal muscle, olm – occipitolateral muscle, otm – occipitothoracic muscle, mab – mandibular abductor, mo – medial occipital muscle, t – tentorium, tmc – tentorial muscle of the cardo, tm – tentorial mental muscles, tms – tentorial muscle of stipes, fl – frontolabral muscle.



FIGURES 23–26. Musculature of the larva of Limnophilus flavicornis (after Winkler):

23 – muscles of the prothorax and foreleg of the larva; 24 – muscles of abdominal segments 2–9; 25 – muscles of the anal legs; 26 – dorsal longitudinal muscles and alar muscles of the blood vessel.

ft – femoral-trochanteral muscle, tfv – tibiofemoral ventral muscle, tfd – tibiofemoral dorsal muscle, bc – basocoxal prothoracic muscle, fpr – femoral pretarsal muscle, vlm – ventral longitudinal muscle of the trunk, cm – cephalic muscles, tpr – tibial-pretarsal muscle, dvm – dorsoventral muscles, adm – accessory dorsal muscle of trunk, ppr – pleural muscle of prothorax, ctrl – coxal-trochanteral lateral muscle, ctrm – coxal-trochanteral medial muscle.

The musculature of the forelegs is illustrated in Figure 23. The muscles of the coxae are situated in the thorax; they originate on the dorsal and 33 pleural sclerites; the forelegs are not only walking organs, they also grasp and have therefore large coxal muscles.

The musculature of the other leg segments is similar. There are two strong muscles in the coxa: the large adductor and the small abductor of the trochanter; the small femoral-trochanteral-muscle runs from the ventral wall of the trochanter to the basodorsal margin of the femur; the greater part of the femur is filled with the large tibiofemoral muscle, the flexor of the tibiofemoral articulation, extending from the basodorsal wall of the femur to the ventral margin of the base of the tibia (m. femorotibialis ventralis); a smaller tibiofemoral dorsal muscle lies in the distal part, the extensor of the tibiofemoral joint (m. femorotibialis dorsalis); inside the tibia passes the tibial-pretarsal muscle consisting of a number of subdorsally originating bundles; the tendon of this muscle passes through the tarsus and reaches the pretarsus; the tarsus is without muscles.

The musculature causing the undulating, creeping and other movements of the abdomen (segments 2–8) has the same arrangement; Figure 24 shows 34 the above dorsal and ventral longitudinal muscles in segments 2–4 and part of the bundles of the dorsoventral annular musculature compressing the segments and extending the abdomen; the deeper muscle layers are shown in segments 5–8. In addition to the longitudinal muscles present in all other segments, the 9th segment contains muscles moving the anal legs (Figure 25); the longitudinal ventral muscle has a large branch attached to the sclerite "c"; this is the flexor of the claw; two small adductors extend from the claw to sclerite "b", raising the claw, and also a lateral adductor of the claw. Figure 26 shows the alar muscles extending the longitudinal blood vessel.

**Intestine and excretory organs.** The intestinal tract is not only internal, but includes also the mouth appendages and the preoral cavity. The intestine extends from the mouth to the anus; it is primitive in the larvae of caddis flies and forms (both in phytophagous and predatory species) a straight tube; it is almost as long as the body. It is divided into stomodaeum, mesenteron and proctodaeum (Figure 27).

(35)

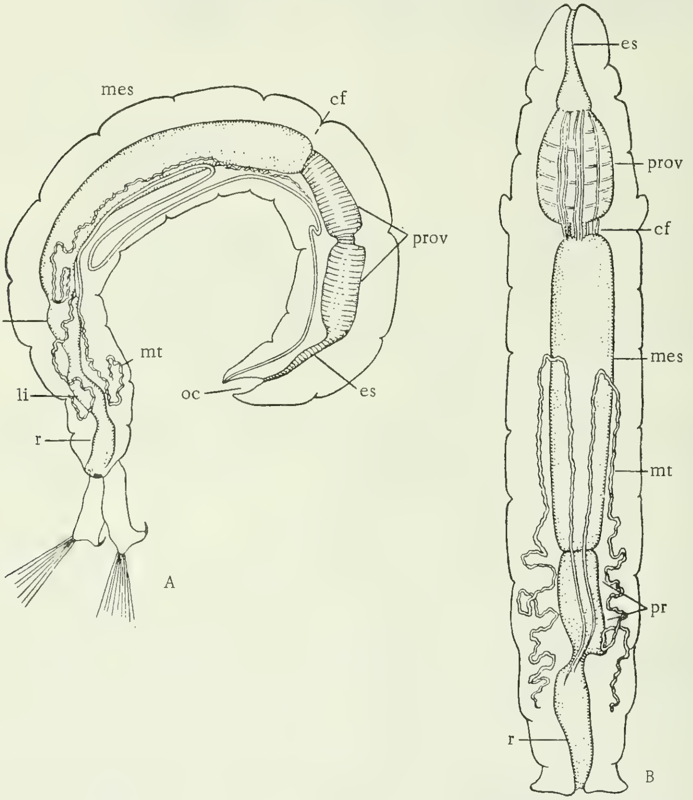


FIGURE 27. General view of the intestine (after Branch). Hydropsychodes sp., lateral (A); Phryganea sp., ventral (B).

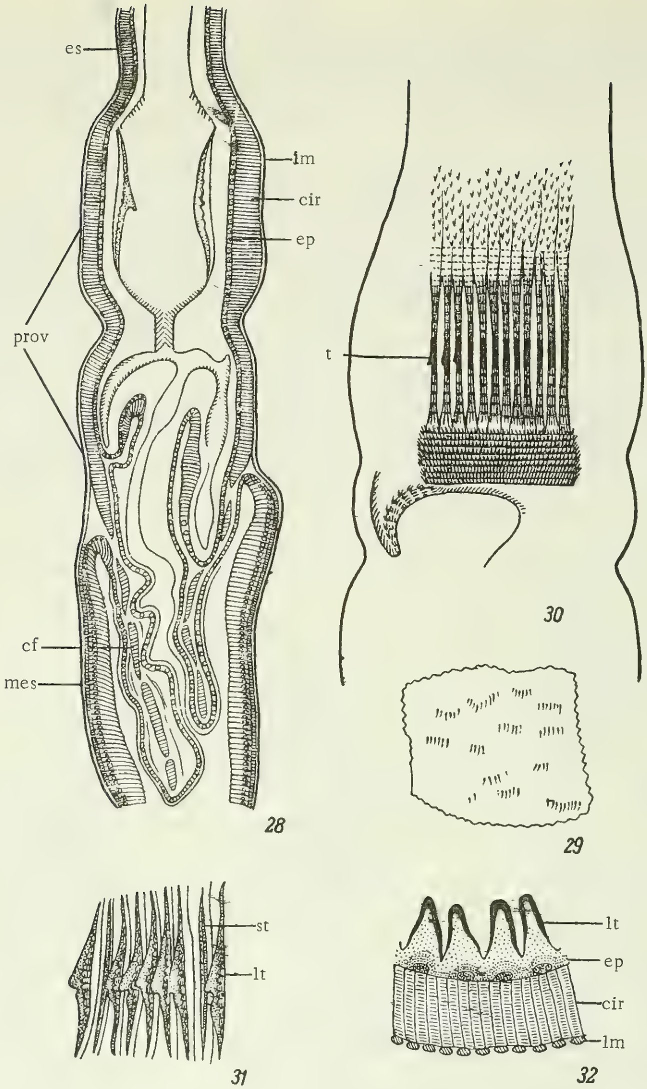
pr – proctodaeum, cf – cardiac fold, mt – malpighian tubules, es – esophagus, prov – proventriculus, r – rectum, oc – oral cavity, mes – mesenteron, si – small intestine, li – large intestine.

The mouth is situated deep inside the preoral cavity, in the region of the clypeus; it leads into the small oral cavity and through the short pharynx into the esophagus, the proventriculus and the cardiac sphincter. The esophagus is a thin-walled tube which is narrow inside the head and then becomes broader; it functions as a crop before passing into the proventriculus.

The proventriculus is the posterior thick-walled part of the stomodaeum; it is not always well marked, but in some groups (Hydropsyche, Phryganea) it is well marked also on the outside of the intestine (Figure 28). The stomodaeum is lined internally with flat epithelium with indistinct boundaries and a thick intima; at the base of the epithelium lies a membrane surrounded in the esophagus by longitudinal musculature, a layer of circular muscles and on the outside by longitudinal muscles. The inner layer of longitudinal muscles of the proventriculus contiguous with the membrane is absent and in the walls of the proventriculus, unlike in other insects, the longitudinal musculature is situated outside the circular musculature (Figure 28) (Noyes, 1915:38, 40; Branch, 1922:266; Snodgrass, 1935:355). The musculature of the proventriculus is better developed than that of the esophagus, and the intima is thicker.

The intima of the anterior part of the esophagus is smooth; that of the posterior part is covered with posteriorly directed denticles which prevent the food moving back (Figure 29). In species of Hydropsyche, the intima of the denticulate part of the esophagus is divided into six longitudinal stripes, each of which bears six secondary parallel folds covered with longitudinal rows of dense, fine denticles. These folds are retained in the proventriculus but the denticles are absent; the surface of the folds is strongly sclerotized, especially on the combs, forming 36 hard, dark brown plates (Figures 30–32) called the teeth of the proventriculus; these teeth are arranged in six groups and each group consists of five large and one
35 small tooth; in profile, a large tooth appears triangular with a long base and a low apex; the small teeth have the form of a rod (Figure 31). The intima of the posterior part of the proventriculus of Hydropsyche contains a ring of several rows of anteriorly directed fine denticles (Figure 30); the anterior part of the proventriculus with its large teeth and strong musculature crushes the food; its posterior part, with its fine denticles acts as a sieve preventing the passage of large food particles into the midgut. The cardiac sphincter or proventricular valve (valvula cardiaca) is a fold of the inner wall of the stomodaeum projecting into the
37 lumen (Figure 28). The intima of the sphincter is without denticles; the epithelial cells (those contiguous with the midgut) are higher than those of the stomodaeum, and have distinct boundaries; there are circular muscles and a layer of longitudinal muscles in the fold; when these muscles contract, the sphincter closes the posterior end of the proventriculus; in the larvae of Hydropsychinae this is affected by two ridges in the lumen of the proventriculus, anterior to the cardiac sphincter (Noyes, 1915:35–36, 40).

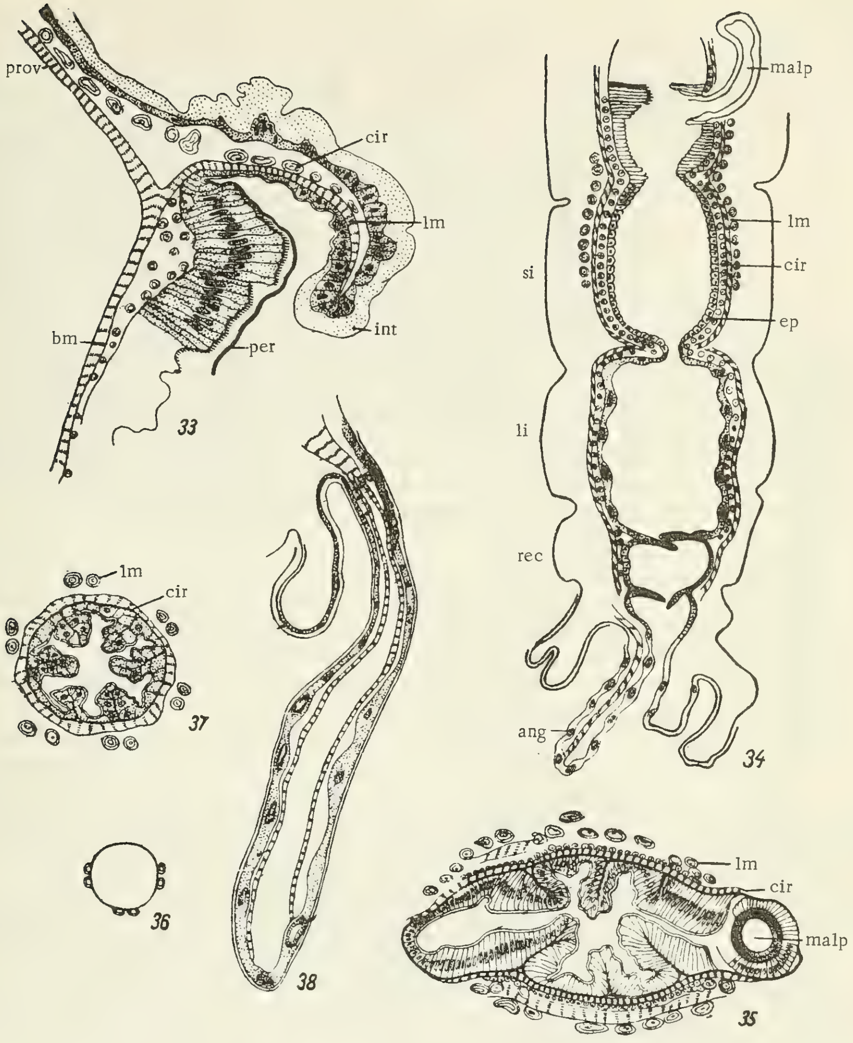
The midgut forms a cylindrical sac or is wider in the middle; it constitutes about half of the intestine (Figure 27). The midgut is lined inside with columnar glandular epithelium; an intima is absent and there is a peritrophic membrane (Figure 33) which envelops the food; according to Martynov (1903) the peritrophic membrane of the larvae of caddis flies is formed by the surface of the epithelium of the midgut. Among the



FIGURES 28–32. Stomodaeum of Hydropsyche sp.:

28 – longitudinal section through the end of esophagus, proventriculus, cardiac fold and beginning of the midgut; 29 – spinules on the walls of the esophagus; 30 – sclerites of the proventriculus; 31 – "teeth" of the proventriculus; 32 – cross section of the wall of the proventriculus (29 – after Vorhies, 28, 30–32 – after Noyes).

lt – large tooth, t – teeth, cf – cardiac fold, st – small tooth, es – esophagus, lm – longitudinal musculature, prov – proventriculus, mes – mesenteron, cir – circular musculature, ep – epithelium.



FIGURES 33–38. Midgut and proctodaeum of Hydropsychodes sp. (after Branch):

33 – longitudinal section at the end of stomodaeum and beginning of midgut in the region of cardiac fold; 34 – longitudinal section of proctodaeum; 35 – transverse section at the beginning of small intestine where malpighian tubes open; 36 – arrangement of malpighian tubes; 37 – transverse section at end of small intestine; 38 – anal (or rectal) gills.

ang – anal gill, bm – basal membrane, int – intima, malp – malpighian tubes, per – peritrophic membrane, lm – longitudinal musculature, prov – proventriculus, rec – rectum, si – small intestine, li – large intestine, cir – circular musculature, ep – epithelium.

cylindrical cells of the glandular epithelium nests of regenerative cells are scattered; they replace cells lost during digestion; cells filled with secretion are almost twice as long as normal cells so that the surface of the epithelium is irregular. The epithelium of the midgut is followed by the thick basal membrane which is first surrounded by circular, then by longitudinal musculature.

(39)

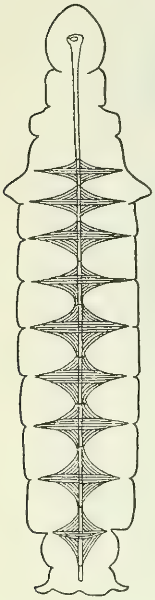


FIGURE 39. Diagram of the circulatory system of Limnophilus sp. (after Branch)

The proctodaeum which is separated from the midgut by a fold is divided into two parts: the small intestine and the large intestine (Figure 27). The histological structure of the intestine does not correspond with its division; it divides the proctodaeum into the following parts; the pyloric sphincter, the small intestine (including the posterior sphincter), the large intestine, and the rectum with the anus (Figure 34).

The pyloric sphincter is situated at the boundary between mesenteron and proctodaeum; the epithelium of this part, like that of the whole proctodaeum, is covered by an intima, but its cells are high, columnar; the walls of the sphincter form six deep folds which project into the lumen (Figure 35); the contraction of the musculature closes the sphincter, separating the midgut from the proctodaeum.

Three pairs of malpighian tubes open in the anterior part of the sphincter: two lateral pairs and one ventral pair (Figure 36); the malpighian tubes of caddis fly larvae are simple, long, curved tubes (Figure 27), lined with reddish-brown glandular cells with large nuclei (Branch, 1922:264–266).

The epithelium of the small intestine is flat, resembling the epithelium of the esophagus; the intima of its anterior part is without denticles; however, there are denticles more posteriorly, and the epithelium of the intestine is folded. The lumen of the small intestine becomes narrower posteriorly; this narrow part, which is surrounded by circular musculature, is the posterior sphincter of the small intestine. The structure of the small intestine (Figure 37), with its wide lumen and strong circular and longitudinal musculature, and the presence of sphincters at both ends indicates that the food is subjected to the digestive juices of the mesenteron and is retained here.

The last part of the proctodaeum is the large intestine and rectum, forming a visicle. The epithelium of the large intestine forms 6 folds projecting into the lumen; the flat adsorbing cells of this epithelium which are covered with a thin intima have large nuclei and a thick protoplasm; the
39 branching of tracheoles is richer in this part than in the preceding one; the musculature consists of circular fibers and 6 groups of longitudinal fibers.

The large intestine is followed by the rectum which does not form a distinct division; the epithelium of the rectum is weakly developed and covered with a thick intima; the folds of epithelium disappear near the anus and the walls of the intestine are smooth; circular musculature forms the weak anal sphincter. The posterior part of the rectum contains the rectal gills (Figure 38) which have an osmoregulatory function.

**Circulatory system and fat body.** The heart of the larvae extends from the 1st to the 9th segment; the aorta extends from the posterior margin of the thorax to the supraesophageal ganglion of the head (Figure 39);

the whole dorsal vessel forms a thin-walled, light tube; in a young, freshly-molted larva, the pulsation of the dorsal vessel is visible through the transparent wall of the body. The first four pairs of alar muscles of the dorsal diaphragm are smaller than the following five pairs; the alar muscles are connected anteriorly and posteriorly. The hemolymph is colorless and light; the protein content of the plasma is low (1.3–2.6% in the larvae of Limnophilus, according to Kuznetsov, 1948:184); its reaction is very constant and resistant to changes of the pH of the environment; in species kept in an alkaline medium (pH 7.60–8.08) or in an acid medium (pH 3.0–6.55), the pH of the hemolymph remained almost unchanged.

With age, the reaction changes (the pH decreases); for example, in larvae of L. flavicornis the pH of the hemolymph decreased from 7.18 to 7.05 during the hot months of the year when the larva grew rapidly (Krey, 1937:203–207).

The fat body of the larva consists of small milk-white lobes; toward the end of the larval life, in the prepupa, the fat body reaches its maximum development and becomes darker.

| | pH of the medium | |
|---|---|---|
| | alkaline | acid |
| Phryganea striata .............. | 6.73–6.78 | 6.71–6.81 |
| Agrypnia obsoleta .............. | 6.98 | 6.80 |
| Molanna angustata .............. | 6.99 | 7.02 |
| Anabolia nervosa ............... | 6.94 | 6.96–7.00 |
| Halesus digitatus .............. | 6.87 | 6.94 |

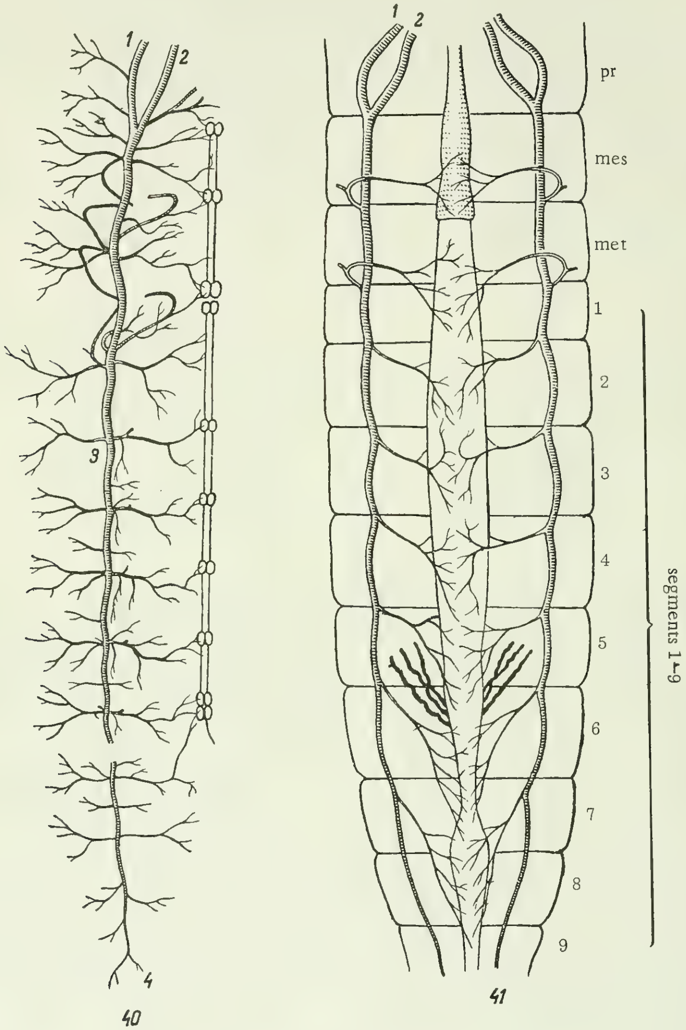
**Tracheal system.** The larvae of Trichoptera have a closed tracheal system; they obtain the necessary oxygen from water, by tracheal gills or through the integument. The main respiratory storage unit is two longitudinal lateral trunks (trachea lateralis) extending from the
41 prothorax to the 9th abdominal segment (Figures 40 and 41); these vessels are thickest in the thorax; their diameter is 0.12 mm in Rhyacophila septentrionis; the lateral vessels taper gradually toward the posterior end of the body and in the last abdominal segment they form thin stems branching in the anal legs into a network of tracheae and tracheoles. In the prothorax, each of the lateral tracheal stems divides into two branches inside the head (Figure 42), the dorsal and ventral tracheae (trachea cephalica dorsalis and trachea cephalica ventralis); the dorsal branch supplies the musculature and nervous system of the dorsal part of the head, including the supraesophageal ganglion, the ventral branch, the ventral and preoral regions of the head, including the subesophageal ganglion and the mouthparts (trachea mandibularis, trachea maxillaris, trachea labialis; Novak, 1952:251–258).

The lateral tracheal trunks in the thoracic and abdominal segments have branches into the legs, the tracheal gills and internal organs, and especially to the ganglia of the abdominal chord and to the intestine (Figure 43).

**Silk glands and Gilson's glands.** The silk glands of the larvae are two long tubes bent twice or more, situated at the sides of the body, ventral to the intestine; they reach the 6th or 7th abdominal segment

(Figures 44 and 114, A). The spinning apparatus is divided into a secretory and an excretory part (Figure 45); both tubes join in the head, forming a common duct which opens at the tip of the labium; the spinning glands of the larva are therefore also called labial glands. Near the boundary of the secretory part, the duct forms an organ which produces the filament (Figure 46), and is called the silk press (Gilson, 1894).

(40)



FIGURES 40 and 41. Tracheae of thorax and abdomen (after Novák):

40 – system of the left lateral trunk of the larva of Plectrocnemia conspersa; 41 – right and left lateral trunks and tracheal system of the intestine of Hydropsyche angustipennis.

1 – dorsal cephalic trachea, 2 – ventral cephalic trachea, 3 – left lateral tracheal shaft, 4 – tracheae of anal legs.

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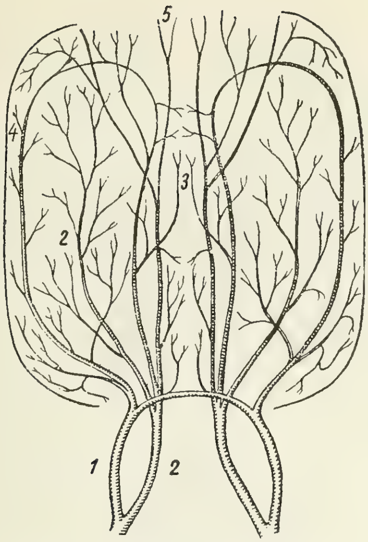

FIGURE 42. Cephalic tracheae of Plectrocnemia conspersa (after Novák):

1 – dorsal cephalic trachea; 2 – ventral cephalic trachea; 3 – trachea of subesophageal ganglion; 4 – trachea of eyes; 5 – trachea of labrum.

(42)

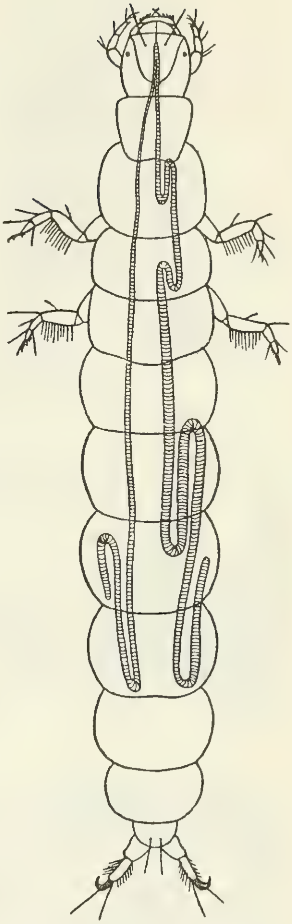

FIGURE 44. Spinning glands of Neureclipsis bimaculata (after Brickenstein)

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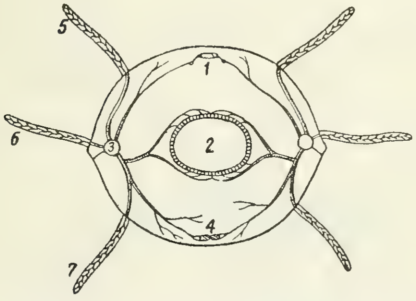
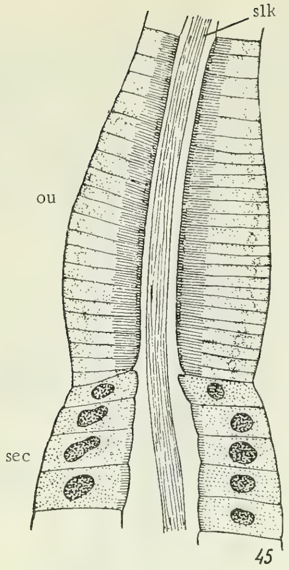


FIGURE 43. Tracheae of the abdomen of the larvae of Stenophylax sp. (transverse section) (after Novák):

1 – dorsal blood vessel; 2 – intestine; 3 – longitudinal lateral trachea; 4 – abdominal ganglion; 5 – dorsal gill; 6 – preoral gill; 7 – ventral gill.

The glandular cells of the secretory part are large with a striated protoplasm which becomes denser near the excretory duct; the nuclei of these cells are large, curved when the cells are young; they later become branched, with large nucleoli and uniformly distributed chromatic granules (Figure 48); during silk secretion the nucleus becomes larger, the chromatin granules



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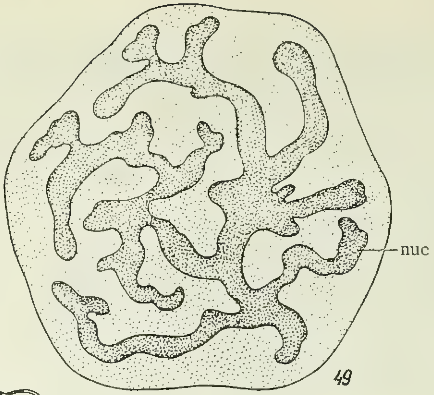

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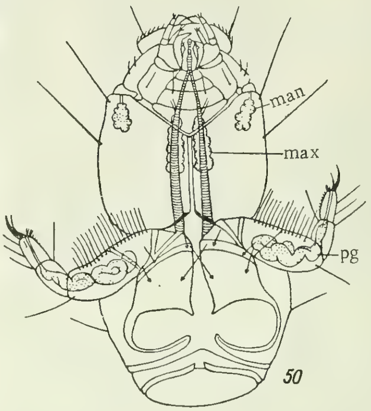

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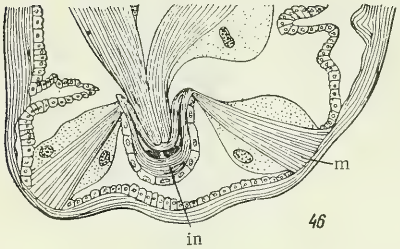

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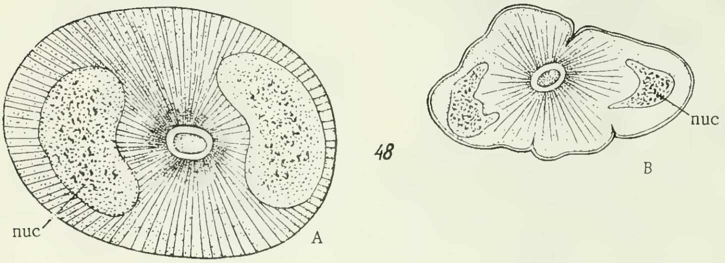

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FIGURES 45–50. Details of the silk glands:

45 – longitudinal section through excretory duct and beginning of secretory part of spinning gland of Limnophilus sp.; 46 – press; 47 – silk thread; 48 – gland cells of secretory part of gland from distal part of the gland of Anabolia nervosa (A) and from basal part of Limnophilus flavicornis (B); 49 – gland cell and its branched nucleus; 50 – pedal, maxillary and mandibular glands of Neureclipsis bimaculata (45, 46, 47, 48, A, 49 – after Gilson; 48, B – after Henseval; 50 – after Brickenstein).

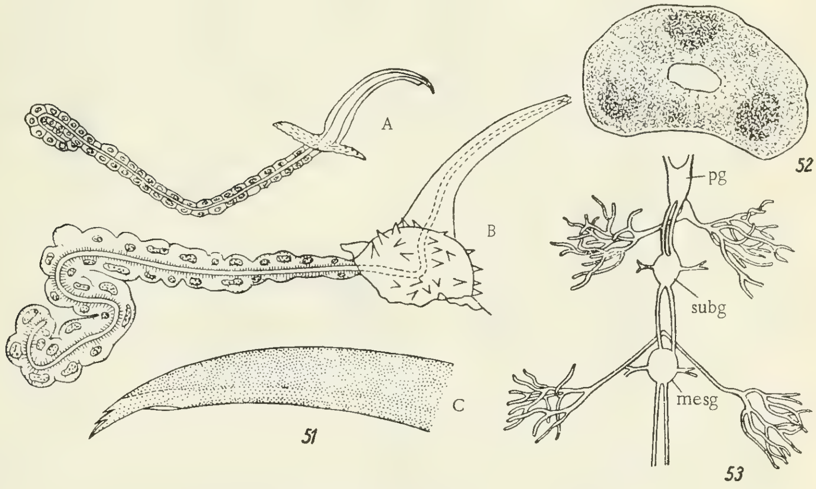
ou – outer part, in – intima, m – muscles, man – mandibular glands, max – maxillary glands, pg – pedal glands, slk – silk thread, sec – secretory part, nuc – nucleus.

42 concentrate near the nucleoli, and vacuoles appear in the cells; the branching of the nucleus becomes more complex (Figure 49). The outer part of the tube is lined with cells with simple nuclei and a thick intima.

The intima retains its elasticity in the press but is denser and thicker, forming an oblong, ridgelike process with an apical tubercle on the wall of the tube; the dorsal ridge projects into the tube of the press; the lumen of the press becomes sickle-shaped in cross section (Figure 46); unlike in caterpillars of Lepidoptera, only two pairs of muscles are attached to the outer walls of the press. The contraction of the muscles widens the lumen of the press, so that it becomes filled with the secretion; the elasticity of the walls closes the lumen, forming the silk; the silk fibers have a slightly flattened cross section (Figure 47) and are divided into two parts by a deep groove. The secretion of the silk glands is a viscous liquid hardening in water to brownish silk. If larvae are fixed, the secretion of the glands becomes hard; when a fixed larva is dissected, the hardened secretion can be extracted in the form of two brown, strong curved rods. The larvae produce a large quantity of silk, so that a larva of Hydropsyche can build its very complicated chamber in two hours.

The pedal glands and Gilson's glands have an accessory function in the building activity of the larvae. The pedal glands (Figure 50) are especially well developed in the Polycentropodidae (Lübben, 1907: Figure 2; Brickenstein, 1955:13, Abb. 10); the main function of the secretion of these glands is adhesive.

(44)



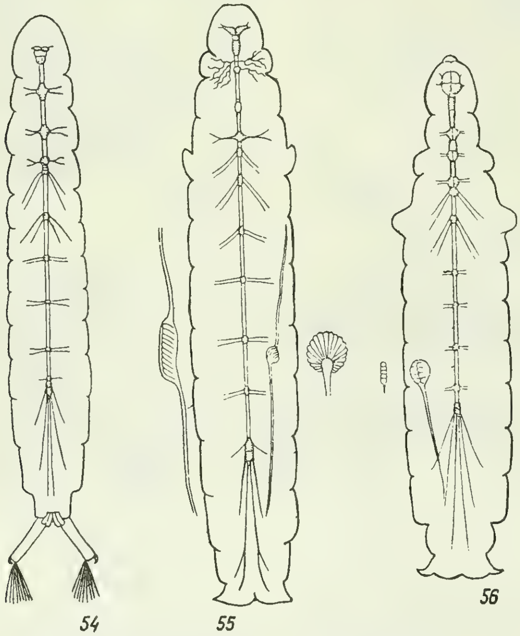
FIGURES 51–53. Gilson's glands:

51 – simple Gilson gland and the prosternal horn of Platyphylax designatus (A), Limnophilus extricatus (B); distal part of the horn and opening of Gilson's gland of L. flavicornis (C); 52 – secretory cells of Gilson's gland of Glyphotaelius pellucidus; 53 – branched Gilson's glands of the prothorax and mesothorax of Phryganea sp. (51, A – after Gilson; 51, B and 53 – after Henseval; 51, C – after Brocher; 52 – after Zarechnaya).

pg – prothoracic ganglion, mesg – mesothoracic ganglion, subg – subesophageal ganglion.

Gilson's glands were first studied in detail in the larvae of Phryganea
grandis, Limnophilus rhombicus, L. flavicornis, L. extricatus
and Anabolia nervosa (Henseval, 1896:329–355) and then in the larvae
of several other species (Vorhies, 1905:118; Branch, 1922:269–270; Brocher,
1923); they are simple or branched tubular glands. In species of Limno-
philinae, Gilson's glands are simple tubes situated in the middle of the
1st thoracic segment; it opens at the tip of the prosternal process ("horn")
of the larva (Figure 51). In species of Phryganea, Gilson's glands are
bilobed and situated in each of the three thoracic segments, near the ventral
nerve chord (Figure 53). The glands of the prothorax are larger than the
other two and their lobes form a network of tubes; the ducts of the lobes
join near the subesophageal ganglion, forming a small reservoir, the narrow
44 duct of which opens at the end of the prosternal horn. The lobes of the glands
of the meso- and metathorax consist of several branches; the excretory
ducts of these lobes join and open in one pore in the intersegmental fold of
the segment. The walls of the gland consist of one layer of large secretory
cells with a radially striated protoplasm and large nuclei (Figure 52). The
secretion of the gland is a transparent oily emulsion (Gilson, 1894; Henseval,
1896; Lübben, 1907: Figure 2; Vorhies, 1905:115–117; Branch, 1922:268–269;
Beams and Wu, 1929:261–278; Haller, 1948:320–328; Brickenstein, 1955:8–13).
The glands of caddis flies of the USSR were described by Zarechnaya (1963).

(45)

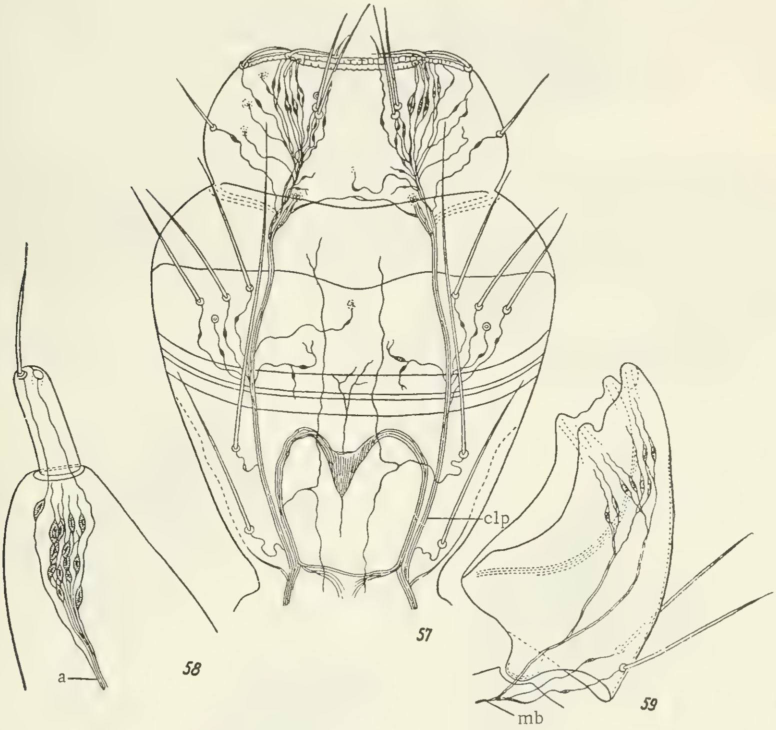


FIGURES 54–56. Ventral nervous system (after Branch):

54 – Hydropsychodes sp.; 55 – Phryganea sp.; 56 – Limnophilus sp. Figures 55 and 56 show the position of the gonads.

**Nervous system.** The nervous system of the larvae resembles in many respects that of caterpillars of Lepidoptera and is relatively primitive. Fusion of the ganglia is barely marked and is developed mainly in the anterior and posterior parts of the ventral chord (Figures 54–56). The peripheral nervous system of larvae with a rich secondary chaetotaxy is complex (Vorhies, 1905:116–117; Branch, 1922:256–259; Racieçka, 1949:2–63; Novák, 1952:252–262).

(46)

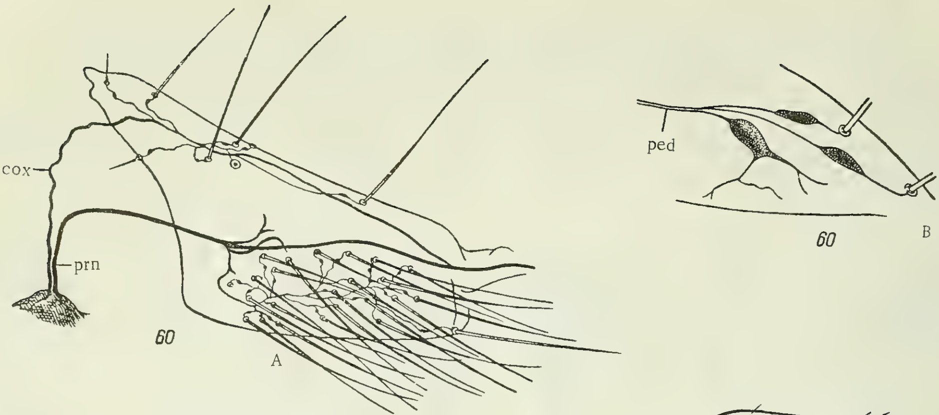


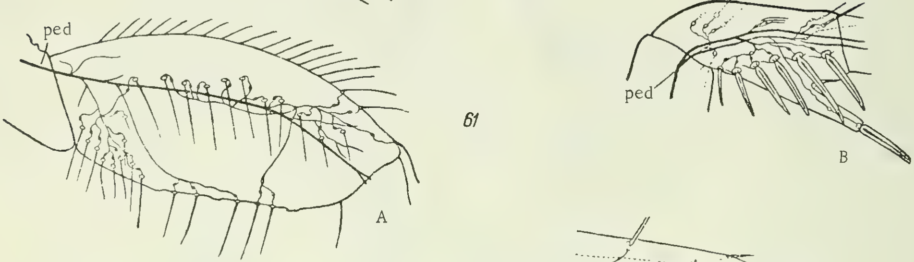
FIGURES 57–59. Cephalic nervous system of Molanna angustata (partial) (after Racieçka):

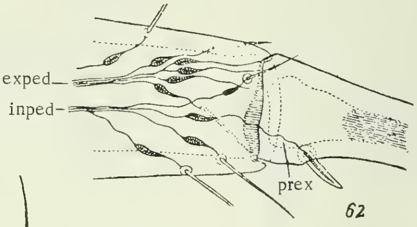
57 – anterior part of frontoclypeus and labrum; 58 – antenna; 59 – left mandible, ventral.

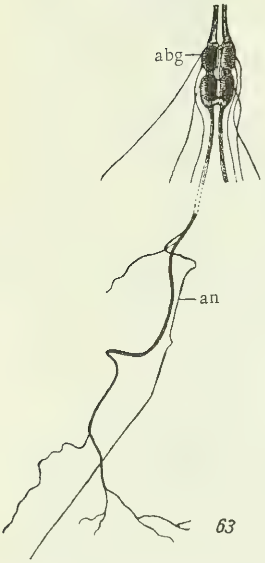
a – antennal nerve, mb – mandibular nerve, clp – clypeolabral nerve.

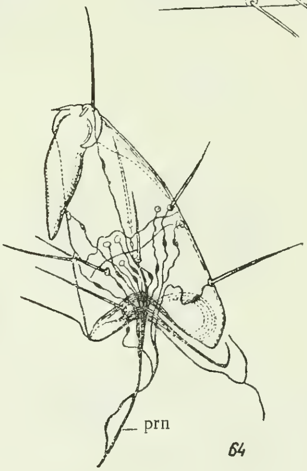
The large supraesophageal ganglion innervates the eyes (nervus ocularis), antennae (nervus antennalis) (Figure 58), labrum and clypeus (nervus clypeolabralis); the small frontal ganglion (ganglion frontale) innervates the frontal region (nervus frontalis) (Figure 57); the subesophageal ganglion provides branches to the mandibles (nervus mandibularis), maxillae (nervus maxillaris), submentum, mentum and labium. The mandibular nerve sends branches to the outer setae; it reaches the upper and lower blades of the mandible in two branches (Figure 59); A network of bipolar sensory cells innervates the trichoid and campaniform sensillae at the base of the setae and in the pits on the head and its appendages and on the whole body of the larva.











FIGURES 60–64. Nervous system of legs and anal legs of Molanna angustata (after Racieçka):

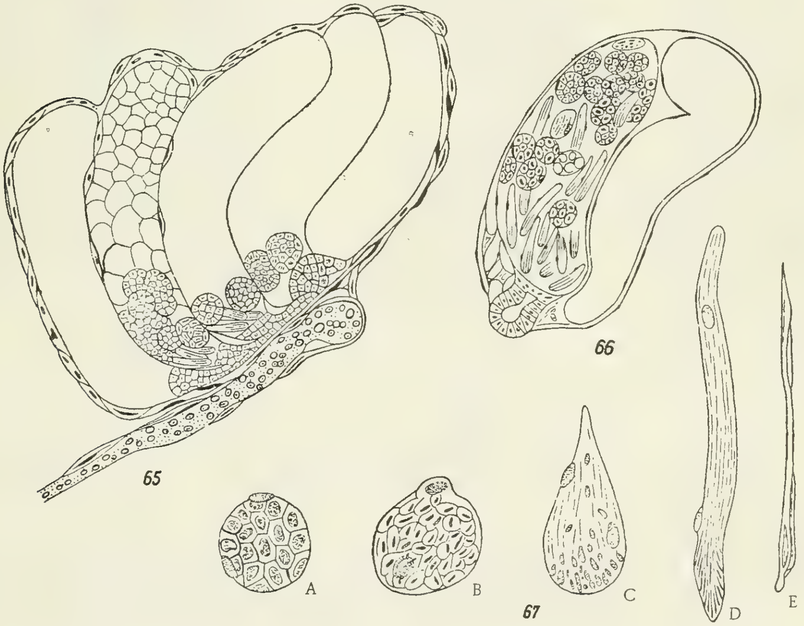
60 – coxa (A) and trochanter (B) of midleg; 61 – femur (A) and tibia (B) of foreleg; 62 – distal part of tarsus and base of claw of foreleg; 63 – last abdominal ganglion and nerve of anal legs; 64 – claw of anal leg.

an – nerve of anal legs, abg – abdominal ganglia 7 and 8, prn – pretarsal nerve, cox – coxal nerve, prex – pretarsal ending of pedal nerve, ped – pedal nerve, inped – inner pedal nerve, exped – external pedal nerve.

The ventral nerve chord consists of three thoracic and eight abdominal ganglia connected by commissures and with the subesophageal ganglion (Figures 40, 54–56). The 1st abdominal ganglion is situated near the 3rd thoracic ganglion in the metathorax; the 2nd abdominal ganglion is situated in the first abdominal segment near its anterior margin; ganglia 3–6 are situated in the corresponding abdominal segments or are displaced to the posterior part of the preceding segment; the 7th ganglion is always situated close to the 8th; both ganglia are situated in the segment immediately posterior to the 6th ganglion (Figure 54) or some distance from this (Figures 55 and 56); the 7th ganglion is sometimes situated near the posterior margin of the 6th segment, and the 8th ganglion is situated near the anterior margin of the 7th segment; both ganglia are rarely displaced to the 5th segment; the 8th abdominal segment sends thick nerves to the anal legs of the larva (Figure 63).

Each of the three thoracic ganglia sends a lateral nerve to each leg; the nerve has a large coxal branch before entering the leg which innervates
46 the dorsal part of the coxa; it then continues into the leg, branching to the end of the tarsus (Figures 60–62); the pretarsus is entered by the end of the tarsus (Figures 60–62); the pretarsus is entered by the end of the nerve innervating the sensilla of the basal seta, but the sensory cell of the nerve is situated in the tarsus (Figure 62) or is rarely situated in the claw (Raciecka, 1949:23–52). The basal part of the claw of the anal leg is more richly innervated than the distal part (Figures 63 and 64).

(48)



FIGURES 65–67. Maturation of sperm cells in the larva and pupa of Limnophilus stigma (after Lübben):

65 – formation of sperm tubes; 66 – transverse section through sperm tube; 67 – stages of spermatogenesis: A – spermatogonium (larva); B – spermatocyte (larva); C – spermatid (full-grown larva); D – spermatocyst (prepupa); E – spermatozoid (mature pupa).

**Genitalia.** The gonads begin to develop already in young larvae, and the female and male gonads are already clearly developed in larvae in the 48 middle of their development. In adult larvae close to pupation, the ovaries and testes are rounded or oblong organs in abdominal segments 4 or 5, or extend to intersegmental regions of these segments (Figures 55 and 56). Among the species studied by us, both the female and male gonads of species Phryganea sp., Anabolia nervosa, A. soror, Limnophilus indivisus, L. affinis are situated in the 5th segment; in L. stigma the testes are situated in the 5th segment, the ovaries in the 4th and 5th segments; in Platyphylax designatus testes and ovaries are situated in the posterior part of the 4th segment and in the anterior part of the 5th segment; in Rhyacophila septentrionis the testes are situated in the 5th segment, the ovaries in the 4th segment (Vorhies, 1905:117–118; Lübben, 1907:102–112; Marshall, 1907; Lutman, 1910; Branch, 1922:259–260; Pkhakadze, 1928:193–199).*

49 The testes consist of tubes or sperm lobes; the testis of caddis flies possesses 5 such tubes (Figures 65 and 66); in mature larvae close to pupation, the cellular elements are zonally arranged (Figure 67); the spermatogonia (A) are at the distal end, the spermatocytes (B) more proximal; at the basal end, closer to the sperm ducts are the spermatids (C); there are spermatocysts (D) in the prepupa, and there is sperm (E) in young pupae.

50 The ovaries consist of ovarioles covered with an amorphous membrane (Figure 68) divided into a terminal filament, the area of the future egg chambers and the pedicel (Figure 69). The ovarioles of young larvae are broad and short; their cellular elements are little differentiated. The ovarioles become elongated as the larva grows. In mature larvae (Figure 70) the walls of the ovariole are lined with small cells of incompletely developed follicular epithelium; there is no division into egg chambers except in the distal region where the cellular elements form groups which are differentiated into oocytes and nutritive cells. The egg chambers become differentiated later, in young pupae (Figure 71); each chamber contains an oocyte and several nutritive cells; the epithelial lining is developed in the basal part of the chamber. The almost mature oocyte and its nutritive cell are illustrated in Figure 72.

## Movement, respiration and feeding

**Movement.** The main method of movement of the larvae is a slow walk, or creeping (rarely running) on the bottom or on the surface of plants and other objects.

The free-living predators of the suborder Annulipalpia (e. g., Polycentropodidae, Hydropsychidae) run rapidly on the bottom or on their nets; their legs are strong, and are of almost equal size. The larvae of Rhyacophila crawl like reptiles, extending the legs laterally and clinging

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* The position of the gonads in the 3rd abdominal segment of the larva as stated by Klapálek (1888:8) has not been confirmed.

(48)

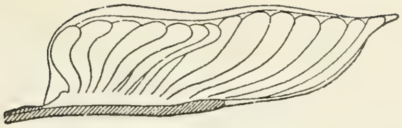
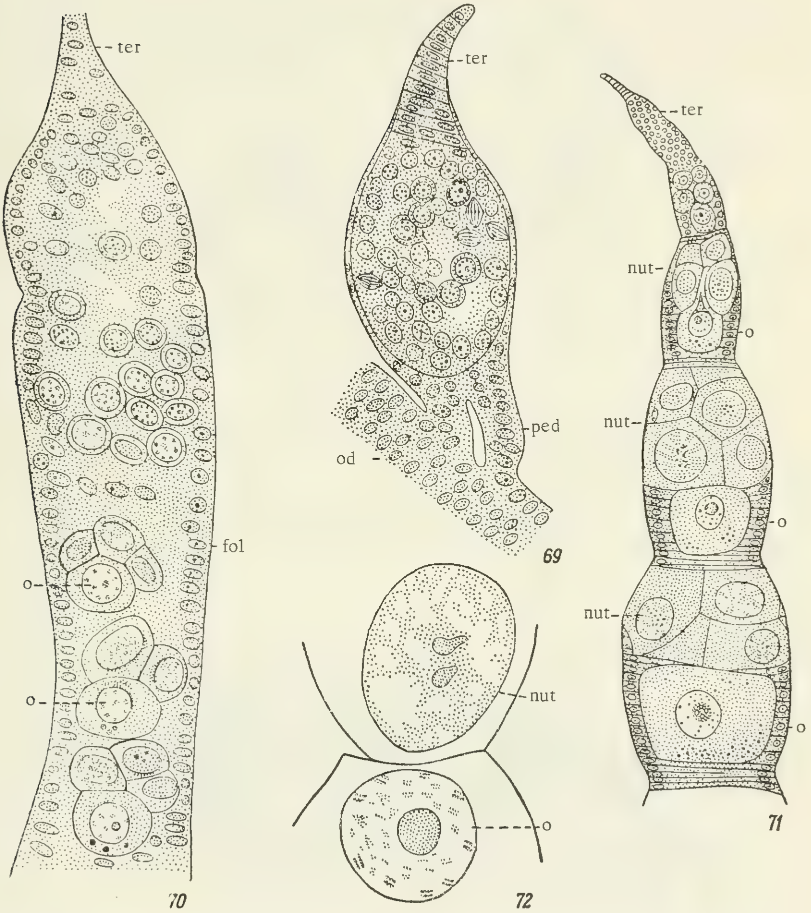


FIGURE 68. Formation of egg chambers in the larva of Anabolia nervosa (after Lübben)

(49)



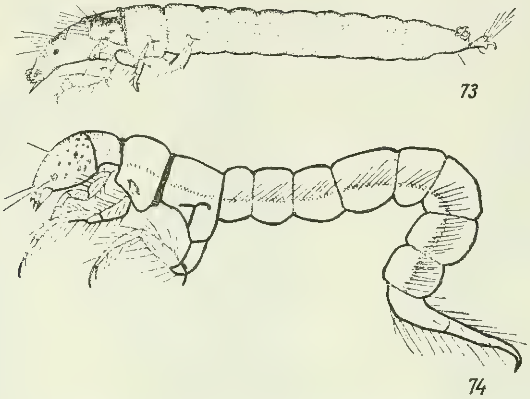
FIGURES 69–72. Maturation of ova in the larva and pupa of Platyphylax designatus (after Marshall):

69 – longitudinal section through the ovariole of a young larva; 70 – longitudinal section through the ovariole of a medium age larva; 71 – longitudinal section through the ovariole of a pupa (egg cells and the nutritive cells accompanying them are shown in the egg chambers); 72 – an almost mature oocyte and the nutritive cell accompanying it, from the ovariole of a mature pupa.

ped – pedicel, nut – nutritive cells, o – oocyte, ter – terminal filament, fol – follicular epithelium, od – oviduct.

to the substrate with their anal legs; when the larvae of Annulipalpia (which build galleries or nets) crawl, the abdomen is extended and the anal legs
51 remain motionless; the larvae rest on them when they wait for prey, bending the abdomen and curving it backward (Figures 73 and 74); this enables them to make a strong forward thrust to catch the prey. The small active larvae of Hydroptilidae are without cases in the early stages, or bear light cases consisting of secretion in older stages; they run rapidly among algae, extending the whole thorax from the case and raising the abdomen.

(50)



FIGURES 73 and 74. Modes of movement of free-living larvae of Annulipalpia:

73 – running larva of Tinodes waeneri (after Hickin);
74 – posture of a larva of Polycentropus flavomaculatus waiting for prey (after Wesenberg-Lund).

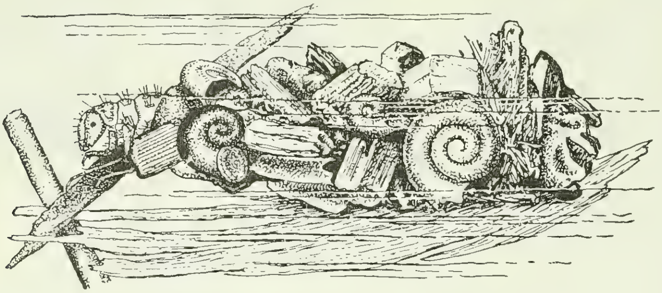


FIGURE 75. Larva of Limnophilus flavicornis

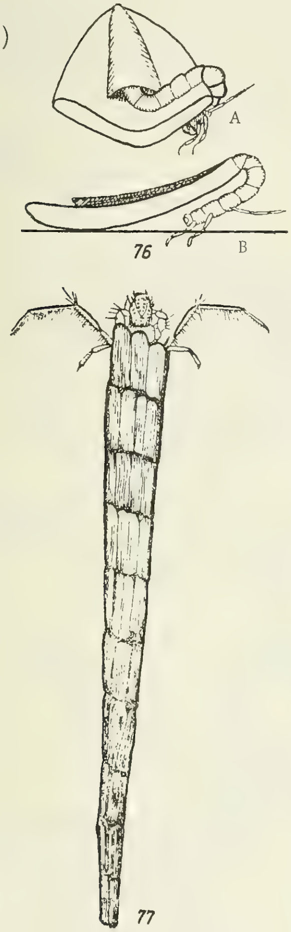
The larvae of Integripalpia which bear cases covered with heavy material move slowly, extending the anterior end of the body from the tube; only the thoracic legs take part in movement; the larvae use the laterally directed claws of the anal legs to cling to the case. Movement with the heavy mineral cases of Potamophylax, Dicosmoecus or Goera or with cases covered with mollusk shells and large fragments of wood (Limnophilus politus, L. flavicornis, L. rhombicus) is possible only if the animal lives in water (Figure 75); when larvae are taken out of the water, they cannot move.

The larvae of Molanna have a special type of movement: they move by leaps; these movements are achieved by a sharp downward inclination of head and thorax and by supporting the body with the forelegs, and this results in a leap forward and (52) slightly upward; the wide wings of the case brake the fall of the case; some observations indicate that this braking effect lasts longer in young larvae with a delicate case than in older larvae. The larva of Molanna is very mobile and flexible; its movements are agile, and when the larva is turned on its back, it extends the body from the case, buries its legs in the sand and restores the normal position of the case with a sharp movement (Figure 76).

There are almost immobile case bearers, e. g., the larvae of Brachycentridae, some of which (Brachycentrus subnubilis or Oligoplectrum maculatum) attach the case to objects, using the legs with their numerous setae and spines as sieves for the collection of prey carried by flowing water.

52 Some larvae can swim, e. g., the larva of Triaenodes bicolor; the femora and tibiae of the hind legs are densely covered with long setae. The light, smooth and conical case of this larva is built of fine, spirally arranged thin plant fragments; the case hangs down when the larva swims. The insect rows with its hind legs, keeping the midlegs folded and the forelegs extended forward. In the family Leptoceridae, the larvae of Setodes tineiformis are good swimmers; this species resembles Triaenodes bicolor ecologically (Figure 77) and lives among plants; it has natatorial legs and its case (which consists of secretion) is lighter than that of Triaenodes bicolor.

Swimming is a rare phenomenon in the late stages of development, but is common in young, freshly hatched larvae; the specific weight of the body with its not yet hardened integument is very small; legs and setae are relatively long (Figures 78–80); these characters make the young larvae similar to plankton and enable them to remain suspended in water for some time, and to move actively but slowly by curving movements of the abdomen. Because of this habit they do not

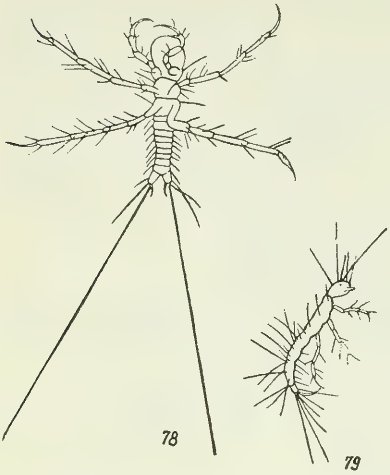


FIGURES 76 and 77. Movements of larvae of Integripalpia in their cases (diagram):

76 – turning the case of the larva of Molanna in a transverse (A) and longitudinal (B) direction (after Dembovskii); 77 – larva of Triaenodes bicolor in swimming position (after Hickin).

concentrate in the same place, but become widely distributed. Some larvae show a positive heliotropism during this period and concentrate in the light part of the aquarium (Triaenodes bicolor).

Some larvae of Annulipalpia which are without cases (Rhyacophilinae, Polycentropodidae) are able to swim during their whole larval life; if such a larva is disturbed, it holds itself in the water by extending its legs and moves (53) by curving movements of the abdomen; these movements resemble (e. g., in Rhyacophila) the movements of a leech; however, the movements of these larvae are less smooth and weaker. Full-grown larvae of some Hydroptilidae with light cases built of secretion (Agraylea, Oxyethira), are also able to swim; they move slowly in stagnant water by rowing movements.



FIGURES 78 and 79. Movement of young 1st stage larva (after Siltala):

78 – Oxyethira sagittifera; 79 – Agraylea multipunctata.

The larvae of Limnophilidae cannot swim. The larvae of species of this family which lay their eggs outside the water (Figures 81–83) are able to move 53 on land when they hatch from the egg; they crawl on the egg mass and then over humid ground or on objects projecting from the water, seeking water. The same has also been observed in the family Sericostomatidae, e. g., in Notidobia ciliaris (Siltala, 1907:338).

**Respiration.** With the exception of larvae of species (Enoicyla) which do not live in water, and except for short periods spent on land when the larvae of some species hatch from the egg, caddis fly larvae spend their life in water, where they live on the bottom or among vegetation; like other aquatic insects with a closed tracheal system, they breathe oxygen dissolved in water.

In the early stages oxygen is absorbed through the thin integument of the whole body; later, respiratory areas become differentiated; they are distinguished by the permeability of the integument and by their light color; most larvae also develop special respiratory organs, the tracheal gills. Species with tracheal gills also have cutaneous respiration, which is proved by the fact that the insect continues to live after the amputation of the tracheal gills.

The larvae of Trichoptera are very oxyphilic and cannot live in water with a low oxygen content; larvae living in flowing water use the current to change the water; those living in cases create an artificial current inside the tube by undulating movements of the abdomen which carry the water through the case. These movements should be regarded as respiratory movements. Free-living mobile larvae living in flowing water do not make respiratory movements; however, when placed in an aquarium, they settle in one place and before they die, begin to make undulating movements with their whole body, like the movements of case-bearing species.

The high oxyphily of the larvae is proved by the fact that they occur only in parts of water bodies with a high oxygen content. One of the optimal habitats which contains a large and diverse fauna of caddis flies is mountain brooks and streams with cold and oxygen-saturated water. The most favorable biotopes of caddis fly larvae in lakes are in the littoral zone; in the surf zone a high oxygen content is ensured by the dynamics of the water, and in plant thickets by photosynthesis. The assimilation of green 54 plants often results in a surplus of oxygen on clear sunny days and in the release of oxygen in form of gas bubbles.

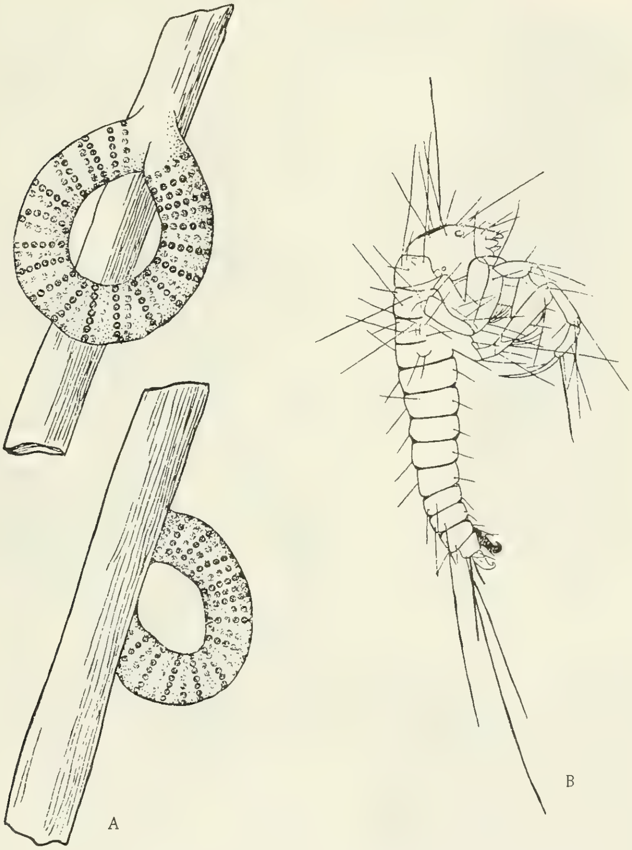
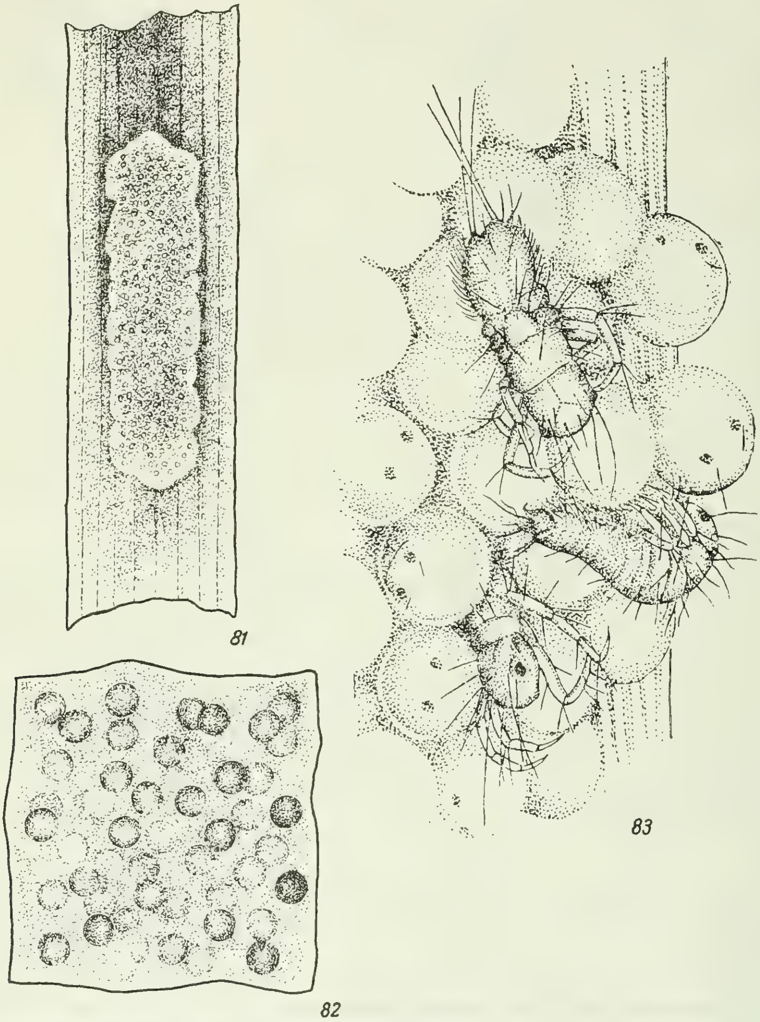


FIGURE 80. Phryganea striata: egg masses (A) and 1st-stage larva (B) (after Siltala)

The oxygen consumption was experimentally determined and calculated for 1 g of live weight of the larvae (Kolenkina, 1951:55); it varies strongly in different conditions and in various species of caddis flies. In mobile larvae of Phryganeidae, for example in almost mature larvae of Oligostomis reticulata the oxygen consumption is 4.22 mg/hour at a

temperature of 16.3°; in larvae of medium age of Phryganea striata it drops to 2.82 mg/hour at 19.8°; in swimming larvae of Triaenodes bicolor (Leptoceridae), 3.7 mm long, it is 2.64 mg/hour at 20.1°, while in the small mobile larvae of Limnophilidae it is much lower: in Nemotaulius punctatolineatus (16.2 mm long, t = 20.6°) it is 1.14 mg/hour, in Limnophilus rhombicus (t = 21.2°) 0.18 mg/hour; in larvae of L. nigriceps, L. decipiens and L. marmoratus (10.6–11.6 mm long)
55 it is 0.38–0.33 mg/hour; the oxygen consumption of a larva of L. bipunctatus, 11.6 mm long, is 4.92 mg/hour at 11.2°.



FIGURES 81–83. Egg masses and young larvae of Nemotaulius punctatolineatus: 81 – egg mass on a reed stalk; 82 – egg masses under high magnification; 83 – eggs with already developed larvae (eyes visible) and hatching of 1st-stage larvae.

**Feeding.** Caddis fly larvae are a highly differentiated group of bottom-dwelling organisms; they feed on a wide variety of organic matter on the
56 bottom. Plant detritus at various stages of decomposition, aquatic plants (and also animals) are their food. Some larvae are narrowly specialized in feeding, but other larvae feed on various foods and under certain conditions may change from their preferred food to a less favorable one.

A large group of larvae feed on detritus of decomposing organic matter with its rich bacterial and fungal flora; numerous species feed readily on fallen leaves when the leaves are already black; thus, the caddis fly larvae form a trophic connection with terrestrial vegetation; species feeding on dead plankton on the bottom also feed on pelagic organisms. Phytophagous species feed on algae and plants of the phytobenthos covering stones. The predators hunt small animals by building nets in which plankton animals are also caught. Species living on mixed food feed both on plant detritus and plants and on minute animals.

Depending on the available food, the feeding of the larva also changes, which explains the frequent differences in observations on the feeding of the same species in different water bodies in different seasons (these observations often refer to larvae of different age).

A number of studies have been made on the feeding of the larvae (Siltala, 1907; Gätjen, 1926; Popova, 1927; Slack, 1936; Kolenkina, 1951; Kashkin, 1958; Kachalova, 1960:149–151; Smirnov, 1962). Feeding has repeatedly been described in surveys and papers on the morphology or biology of species of caddis flies.*

In the suborder Annulipalpia, mixed feeding exists in the microphagous larvae of Psychomyiidae and Philopotamidae which live in curved vermiform galleries (Psychomyiidae) or in long tubes which are wider at the end (Philopotamidae) built on the bottom, on stones or other objects; these larvae collect particles of slime, fine detritus and minute animals together with fungi and bacteria which develop in brownish slimy deposits on the tubes; larvae of Philopotamidae collect this mixed food with the membranous labrum with its comb of thin, curved, hairlike spinules at the anterior margin (Figure 84), and with tufts of long hairs on the maxillae. In the suborder Annulipalpia, phytophagous feeding is characteristic for the case-bearing larvae of Glossosomatidae, which feed on plants clinging to stones;
57 among these plates diatoms which are eaten together with other algae, bacteria and other microfauna predominate. The larvae scrape off the plants with their long spatulate mandibles (Figure 85); after having eaten the plants at one end of the case, the larva turns round in its case and eats the plants at the other end of the case, and then moves to a new feeding surface, Hydroptilidae (Figure 86) are highly specialized phytophages of Annulipalpia, especially species of *Agraylea*, *Oxyethira* and others, as they feed on filamentous algae; they move along a thread, bite through one cell after another and suck out the content; the intestine of the larva becomes green; the larvae of *Orthotrichia tetensii* feed on large unicellular algae (Figure 87).

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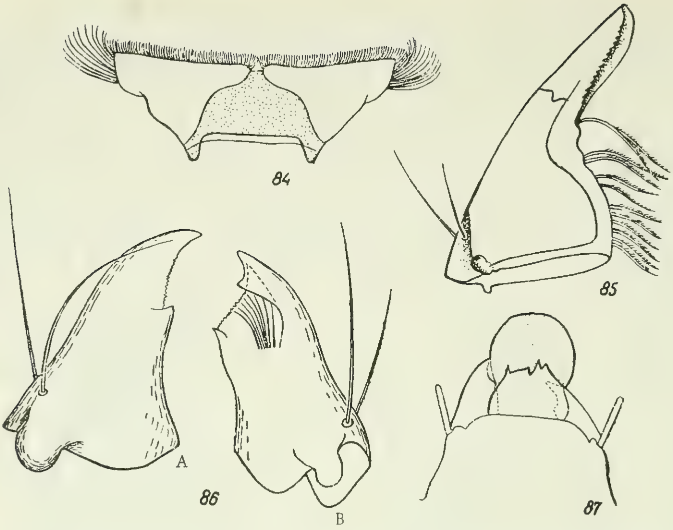
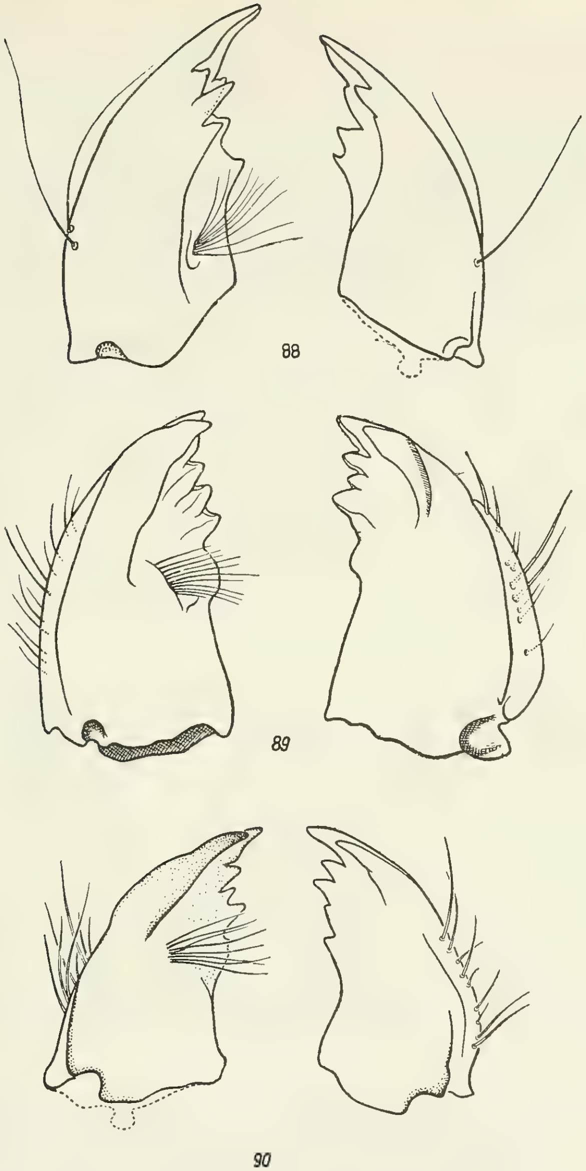
* The old literature on the feeding of caddis fly larvae (including Réaumur, 1737:155; Pictet, 1834:113–114; Kolenati, 1848:51; Klapálek, 1888:12; McLachlan, 1863:8532–8533; Fr. and Müller, 1879:387; Goody, 1880:146; Ulmer, 1900:850) and other sources on this problem has been listed by Siltata (1907:29–34). The feeding of Hydroptilidae has been described by Nielsen (1948:163–166). Satija (1959a, 1959c) deals with the feeding of some species and also gives descriptions of these species and of the characteristics of their intestine.



FIGURES 84–87. Mouthparts of microphages and phytophages of Annulipalpia:

84 – labrum of Wormaldia subnigra; 85 – left mandible of Mystrophora altaica; 86 – mandibles of Hydroptilidae: right mandible of Orthotrichia tetensii, ventral (A), left mandible of Ithytrichia lamellaris, ventral (B); 87 – larva of Orthotrichia tetensii after feeding on an alga (84 – after Hickin, modified; 86 and 87 – after Nielsen).

The larvae of Polycentropodidae, Arctopsychidae and Hydropsychinae with their strong toothed mandibles (Figures 88–90) are mobile and strong predators; they jump on their prey, which is often larger than themselves. In an aquarium for example, the larva of Hydropsyche was observed to attack a larva of Tendipes which approached its shelter; it rapidly devoured the larva from the soft posterior end, leaving only the head capsule; this larva also feeds on small animals and plant particles carried by the current into its characteristic net (see below); in winter, when nets are not
59 built, the role of vegetation increases in the food of the larva; when the larva is starved, it gnaws plant fragments from the wall of the case and from the vicinity. In the intestine of larvae of Hydropsyche (H. angustipennis, pellucidula, instabilis, fulvipes) animal remains together with plant particles predominated in summer; among them were heads and whole larvae of Chironomidae, larvae of Simulium, of small mayflies and caddis flies (including young Rhyacophila), parts of caddis fly pupae, mandibles and parts of legs of insects; threads of algae, fragments of sphagnum, diatoms, parts of plants. It is interesting that no shrimps were found in the stomach of larvae of Hydropsyche although shrimps were common in their habitats; the larvae attempt to catch the shrimps but cannot hold them because of their smooth and hard integument (Sattler, 1958:173, 176–177).



FIGURES 88–90. Mandibles of predators of Annulipalpia (left and right mandibles, dorsal):

88 – Polycentropus flavomaculatus; 89 – Hydropsyche angustipennis; 90 – Arctopsyche ladogensis.

The feeding of the larvae of Annulipalpia is thus narrowly and diversely differentiated, according to their mode of life and the nets built by the different species: the microphages build galleries and are omnivorous; the free-living species which build capturing nets are predators; the case-bearers are phytophagous.

In the suborder Integripalpia, the larvae of which are all case-bearers, feeding on decomposing and fresh plants predominates; there are no real predators in this suborder; however, larvae of this suborder are often 60 forced to eat animal food; feeding on animals and minute dying animals is characteristic for only a few forms. The mandibles of detritophages and phytophages are illustrated in Figures 91–93.

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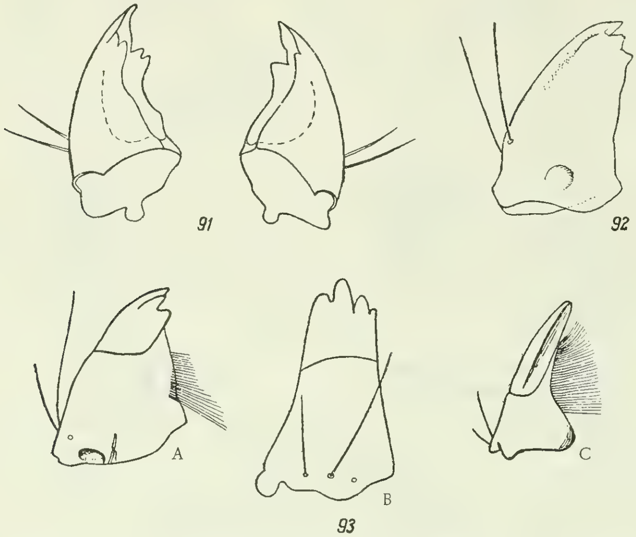

FIGURES 91–93. Mandibles of detritophages and phytophages of Integripalpia:

91 – Agrypnia obsoleta, right and left mandibles, dorsal; 92 – Triaenodes bicolor, left mandible, dorsal; 93 – Limnophilidae (after Nielsen). Potamophilax nigricornis, left mandible, dorsal (A) and outer side (B), Apatania müliebris, right mandible, ventral (C).

The family Phryganeidae consists only of phytophagous forms feeding on detritus and live plants; the feeding of the larvae of this family has been studied in detail (Siltala, 1907:12–14; Gätjen, 1926:653–666); Kolenkina (1951) studied the feeding of several species experimentally.

In the stomach of larvae of Phryganeidae which were studied (Holostomis phalaenoides, Oligostomis reticulata, Hagenella clathrata, Neuronia ruficrus, Phryganea striata, Ph. grandis, Agrypnia obsoleta, A. varia, A. pagetana, Agrypnetes crassicornis, Nannophryganea minor), there were always large quantities of terrestrial and aquatic plants together with whole or broken cells of algae; animal remains were absent or present in small numbers.

The larvae of three species of Phryganeidae were placed in so-called "courtyards"* in which they were offered various vegetable foods; the larvae of Phryganea striata rejected some of these foods but showed a distinct preference for detritus of fallen leaves; they readily fed on filaments of Cladophora; the same food and also pine needles were preferred by the larvae of Oligostomis reticulata and Neuronia ruficrus. When the larvae of the same species were starved and then offered any kind of food, e. g., tree leaves, their daily food index** varied from 58.2–80.7%, i. e., it was high; when they were fed with Cladophora, the index was higher: 74.8–88.0%; when deprived of vegetable food, the larvae also took animal food, but showed a low daily food index: feeding on oligochaetes: 6.3–16.8%; on Chironomidae: 2.8–10.0%; on Daphnia: 4.9–11.8%; if both vegetable and animal food was available, the larvae of Phryganeidae rejected animals and always fed only on plants; the larvae of Phryganeidae thus change to animal food only if forced by starvation; animal remains repeatedly found in the stomach of the larvae of Phryganeidae are mainly small animals accidentally swallowed together with vegetable food.

The larvae of Leptoceridae are for the most part phytophagous. They consume large quantities of vegetable food, e. g., the daily food index of young larvae of Mystacides longicornis and Leptocerus senilis is 102.7–107.8% when fed with Cladophora; these larvae reject animal food (oligochaetes, Tendipedidae, Daphnia) even when starving.

The larvae of L. senilis and L. fulvus are often found in lakes among plants on stones; in oligotrophic lakes, these plants are mainly diatoms; the larvae of L. fulvus penetrate deeply into these thick, slimy 61 incrustations and are often completely buried in them. Both species live well on vegetable food and do not feed on small animals even when starved; however, it is interesting that in some places they feed on larger animals in plants growing on stones, e. g., on sponges; they eat galleries into the sponges; it is possible that these species consist of two different physiological races with a different type of feeding; the stomach of larvae taken from sponges are filled with spicules of sponges (Siltala, 1907:16).

The larvae of Oecetis furva are typical inhabitats of overgrowths on stones; their cases consist of plant particles and they feed on very diverse vegetable food; in experiments in the "courtyards" the larvae showed an equal preference for decomposing tree leaves, threads of Cladophora and Vaucheria and coarser vegetable food, e. g., sedge leaves. When starved, these larvae eat small numbers of Daphnia (food index 2.4%); animal remains are frequently found in the stomach of Oecetis furva larvae caught in nature (frequency 41.6%).

When the bottom inhabiting species of Oecetis (Oe. ochracea, Oe. lacustris) (which build cases of sand) are fed with vegetable and animal food, they accept both readily; they are thus typical representatives of the group of larvae of Leptoceridae with mixed feeding, although their dagger-shaped mandibles seem better adapted for feeding on animals.

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* "Courtyards" are a device for the study of the selective ability of invertebrates for various kinds of food, suggested by N.S. Gaevskaya (1939:1064–1066). It is a round aquarium divided into sectors ("courtyards") by small partitions which do not reach the middle of the aquarium. Different foods are placed in each "courtyard"; the animals are placed in the center of the aquarium; they crawl freely from one courtyard to another, and concentrate in greatest numbers in the courtyard containing the preferred food.

** Food index is the ratio of the weight of consumed food to the weight of the body of the larva (in %).

The family Molannidae is the only group of Integripalpia which includes species feeding on animal food. Under experimental conditions, the larvae of Molanna angustata rejected vegetable food even when starved; they consume large numbers of animals; when they feed on oligochaetes, their daily food index is 61.1%, on Tendipedidae it is 41.8%, and on Daphnia 80.5%. Plankton organisms are more numerous than bottom organisms in the stomach of larvae caught in nature; for example, in the stomach of Molanna angustata, the frequency of Daphnia magna was 68.6%, of D. pulex 37.5%, of Bosmina sp. 43.6%, of Chydorus sphaericus 21.8%, of Copepoda 25%, of Rotatoria (Anuraea aculeata, Brachionus mülleri) 46.9%, but oligochaetes were found in only 12.5% of the dissected stomachs and Tendipedidae in 40.5% (Kolenkina, 1951:47). The stomach of the the larvae of Molanna angustata also contained planktonic and planktonic-benthic forms Daphnia longispina, Bosmina longirostris, Camptocercus rectirostris, Alona rectangula, Graptoleberis testudinaria, Rhynchotalona rostrata, Paracyclops fimbriatus, Canthocamptus sp. (Krokhin, 1929:73). These data show that the larvae of Molanna are typical but not exclusive plankton feeders; plankton organisms are the main food of these larvae, and bottom organisms are secondary.

It may be asked how a slow-moving, bottom-inhabiting insect catches plankton animals. This is naturally possible only after the death of the plankton animals; the larvae of Molanna which live on the bottom feed on the falling "rain of corpses"; they collect this food on the bottom, but they also swallow small, live animals which live temporarily or permanently on the bottom, e. g., species of Alona and Rhynchotalona, Paracyclops fimbriatus, Acanthocyclops viridis; species of Canthocamptus; animals living in the bottom soil (Oligochaeta, Tendipedidae) are less accessible to the larvae of Molanna.

In the stomach of Molannodes tincta both animal and vegetable food was found (Siltala, 1907:15).

62 The feeding of the large larvae of the family Limnophilidae was studied repeatedly; These species were correctly described as phytophagous. The data collected refer to the feeding of a large number of species of Limnophilidae, including such widely distributed species as Nemotaulius punctatolineatus, Glyphotaelius pellucidus, Grammotaulius atomarius, Limnophilus rhombicus, L. nigriceps, L. politus, L. flavicornis, L. stigma, L. marmoratus, L. vittatus, L. centralis, L. sericeus, L. bipunctatus, L. extricatus, L. indivisus, L. lunatus, Anabolia nervosa, A. soror, Colpotaulius incisus, Halesus interpunctatus, H. digitatus, Chaetopteryx villosa, Platyphylax digitatus, Micropterna lateralis, Potamophylax nigricornis, Apatania fimbriata. Observations on the feeding of these species and analyses of the contents of the intestine established that plants and algae predominate in their food; some species (L. nigriceps, L. rhombicus, L. decipiens, L. bipunctatus and Nemotaulius punctatolineatus) also eat moss; animal remains are rarely found in the stomach of the larvae of the above species but in small numbers, and not in all species.

Kolenkina (1951:46) studied in detail the stomach contents of 16 specimens of Nemotaulius punctatolineatus, 19 specimens of Anabolia nervosa and 122 specimens of the species Limnophilus (L. nigriceps, L. decipiens, L. bipunctatus, L. rhombicus, L. politus, L. stigma, L. marmoratus); she found in all intestines without exception remains of plants and algae (Oedogonium, Cladophora, diatoms, etc.).

Animal remains were found only in the stomach of one species — L. rhombicus (frequency 17.8%). When the larvae of the above nine species were fed with mixed food, they accepted only vegetable food; when fed with vegetable food, they readily fed on fallen leaves and Cladophora; the food index for leaves was 98.6% in Nemotaulius punctatolineatus, 67.3—87.0% in the other species; for algae, the food index of L. bipunctatus was 94.0% and in the other species 78.8—88.1%. If there was no vegetable food, starved larvae of N. punctatolineatus began to feed on oligochaetes (daily food index 5.8%), rejecting Chironomidae and Daphnia; the larvae of L. nigriceps reject Daphnia but eat oligochaetes and Chironomidae (daily food index 6.0—7.4%); when L. decipens, L. bipunctatus, L. rhombicus, L. politus, L. marmoratus are deprived of plants, they eat small numbers of all three species of animals offered, and their daily food index varied from 1.2 to 8.0%; only two species (L. bipunctatus and L. politus) had a food index of 27.2% and 17.4%, respectively, when fed with oligochaetes. Larvae of Limnophilidae apparently feed on animals only when forced; this is rarely observed in nature where vegetable food is abundant. This seems correct for the above studied endemic limnophilic species which live in shallow water, well warmed in summer and with a rich vegetation. However, the feeding of rheophilic species of Limnophilidae in cold mountain streams is apparently different; for example, in the Teberda River, at an altitude of about 1,300—1,400 m, when larvae of Rhyacophila and large, well-fed larvae of Halesus 20—22 mm long were caught in a dish near the bank of the river (water temperature about 10°) on 23 July 1954; the Halesus larvae attacked the Rhyacophila larvae immediately and devoured them (E. A. Tetyueva).

When fed with different types of vegetable food in the "courtyards" Limnophilus rhombicus, L. nigriceps and L. decipiens preferred tree leaves but also fed on Cladophora (the first two species) 63 and Hypnum; the larvae of L. rhombicus ate the alga Hydrodiction and sedge leaves; the larvae of L. nigriceps fed on Elodea; fallen tree leaves were found in large quantities in the food of L. politus and L. bipunctatus, but the former species preferred Cladophora and Hypnum while the second preferred Cladophora and pine needles. The readiness of the larvae to feed on decomposing tree leaves may be due to the nutritive value of the leaves and to the bacterial and fungal flora on them. O. L. Kachalova bred larvae of L. nigriceps in a dish with black leaves; she observed that the larvae feed readily on hyphae of the mold developing on the leaves in neglected aquaria; the larvae grew and developed well on this food.

When deprived of food, the larvae of species of Limnophilus eat each other on the second day of starvation; they first eat the vegetable case and then the larva itself. Limnophilidae (and Phryganeidae) can stand starvation for a long time; a starved medium-sized larva of Limnophilus politus died on the 18th day (water temperature about 19°); a larger larva of L. rhombicus lived for 47 days without food.

The larvae of Apataniinae, which are very small, live on stones, on the open shore of lakes, in brooks and springs, where they feed on plant overgrowths of stones; in addition to algae, the high nutritive value of these overgrowths is provided by the bacterial and fungal flora among the algae and on the surface of stones; in Lake Baikal, species of the tribe Baicalinini develop in large numbers on this food, covering the stones sometimes almost completely. The larvae of Apataniinae sometimes use their elongate spatulate mandibles to scrape the incrustations from the stones; these mandibles are a convergent character present in different, often remote groups of caddis flies with a similar mode of life and method of feeding; in the subfamily Limnophilinae, such scraping mandibles are present in the larvae of Ecclisopteryx guttulata which feeds on overgrowths of plants; in the suborder Annulipalpia such mandibles are present in species of Glossosomatidae.

(64)

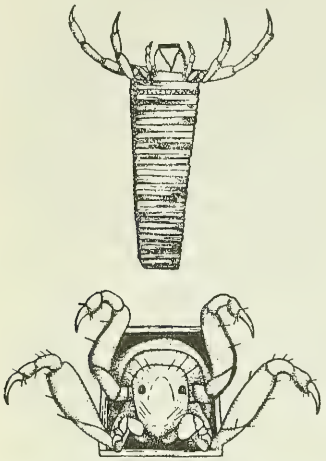


FIGURE 94. Larva of Brachycentrus waiting for prey (after Murphy)

The feeding of the larvae of Goeridae, Lepidostomatidae, Brachycentridae and Sericostomatidae (formerly united in the family Sericostomatidae) has not been sufficiently studied. The view on the exclusively phytophagous feeding of the larvae of these families (Siltala, 1907:21–22) based on examination of the intestine of a number of larvae cannot be applied to the family Brachycentridae, the larvae of which feed both on vegetable and animal food. In the intestines of Goera pilosa, Lithax obscura, Silo nigricornis and S. pallipes (Goeridae) algae and plant fragments were found; in the intestine of Lepidostoma hirtum and Crunoecia irrorata (Lepidostomatidae) there were algae and plant detritus; the intestine of Notidobia ciliaris (Sericostomatidae) was filled with leaves of moss (this species inhabits moss-covered stones); remains of Copepoda and insects were found only in the intestine of Sericostoma personatum, although vegetable food was plentiful (Slack, 1936:107). The observations on the larva of the American species Brachycentrus nigrosoma made by Murphy (1919:155–158) showed that the freshly located larvae of Brachycentrus remains near the shore, in calm, small inlets among stones; during the first five hours of their life they build the cases and feed on diatoms (Cymbella, Navicula, Synedra); in the third week they begin to add filamentous algae to the diet (Oedogonium, Cladophora, Ulothrix) and higher plants; the larvae move to the water current after 6 weeks, where they attach the case to a stone so that their anterior end faces
64 the current. The larva then assumes a posture of waiting for prey in its case (Figure 94): its head is inclined forward, the forelegs are extended beyond the head; the long midlegs are held upward and the hind legs are extended laterally. Animal food, consisting mainly of small Crustacea and insects (mayflies, Tendipedidae), begins to predominate in the intestine of

the larvae at this time. The catching of prey was studied in the laboratory; the larvae were placed in a glass tube of about 3.5 cm width; some small stones were placed in the tube and sand was cemented to the wall of the tube; a rubber tube ending in a funnel was placed in the tube; and it was thus possible to create a water current in the tube; the current could be regulated and animal food was added. When the current was interrupted, the larvae did not notice Cyclops and Daphnia near them; however, when the current began, the larvae caught the Crustacea. The small larva caught large Daphnia almost half as long as itself; the larva also caught Cyclops and hydrachnids with a strong carapace. During the time the larva catches prey, it collects also detritus and plankton, keeping it on its femoral combs, and eats algae, zooplankton and small plant fragments.

## Growth, molting and number of larval instars

The molt of the caddis fly larvae, especially that of Annulipalpia has hardly been studied. The larvae of Rhyacophila were sometimes found hidden among loosely connected sand grains or small stones, quite different from their massive pupal case. These primitive structures are probably temporary; they are attached to the substrate, built by larvae living in flowing water for molting.

The molt of the case-building larvae of Annulipalpia and of all Integripalpia takes place inside the case. The larva attaches the anterior margin of the case to an object; it then shuts itself in the case with a thin membrane at the anterior opening; some species cover the anterior end with a special hood of sand grains (Silo nigricornis). Species living in calm
65 habitats, e. g., Crunoecia irrorata (at the edge of springs, among moss or humid fallen leaves) do not attach the cases for molting, as there is no danger of being carried away.

During the relatively long larval stage of caddis flies, the larva has 4 molts, so that there are 5 stages. This number of stages is characteristic for the order; the larva of some species, e. g., Agapetus fuscipes, molts 6 times, so that there are 7 larval stages; the larvae of Sericostoma molt 5 times, i. e., 6 larval stages (Nielsen, 1942:262–263). The penultimate molt (into the pupa) takes place in the case; the last molt (into the imago) takes place when the insect passes from water to land.

The growth rate of parts of the body is not uniform. The soft abdomen of the larva grows continuously during all stages; on the other hand, sclerotized parts of the body (head, prothorax, legs and anal legs) grow only when the larva molts, during the interval in which the old integument has been shed and the new one has not yet hardened. The length of the body cannot be used as a character of the stages, because the abdomen increases in size during each stage, while the size of the sclerotized parts, especially the width of the head, remains constant. The width of the head is a reliable morphological index to distinguish stages of larvae in the population.

The body of the larva is more or less transparent during the whole 1st stage; head, thorax and legs are of a relatively large size, but the abdomen is short and narrow; the 1st abdominal segment is without tubercles in Integripalpia. The sclerites are thin, the sutures are absent or not fully developed; they are not pigmented, or pigmentation is weak; the setae are primary and relatively long, sometimes very long. The form of the larva and the ratio of its individual parts change little from the 2nd stage, but the number of secondary setae increases with each stage.

The postembryonal development varies according to climatic and food conditions; the early stages are shorter than the later ones. In insects with an annual cycle of development, the winter stage is the longest. Some species have two generations per year. From the eggs of the spring generation hatches the summer generation which ends development in a shorter time than the autumn generation; the development of the autumn generation is interrupted by hibernation in one of the later stages and is prolonged. The shortest larval life has been observed in the small species of the family Hydroptilidae; Agraylea multipunctata reaches the 5th larval stage 25 days after oviposition (Siltala, 1907:328).

Together with their growth, the larvae of Annulipalpia increase their shelters and capturing nets; in colonies of Neureclipsis bimaculata,
66 their capturing tubes are easily observed. In the larvae of Integripalpia which hibernate as larvae, growth in winter is slow; growth in spring and early summer is most intensive; the growth is accompanied by adding to the case; according to observations of Hanna (1957a–1957b; 1959) the growth of the case lags to some extent behind the growth of the larva.

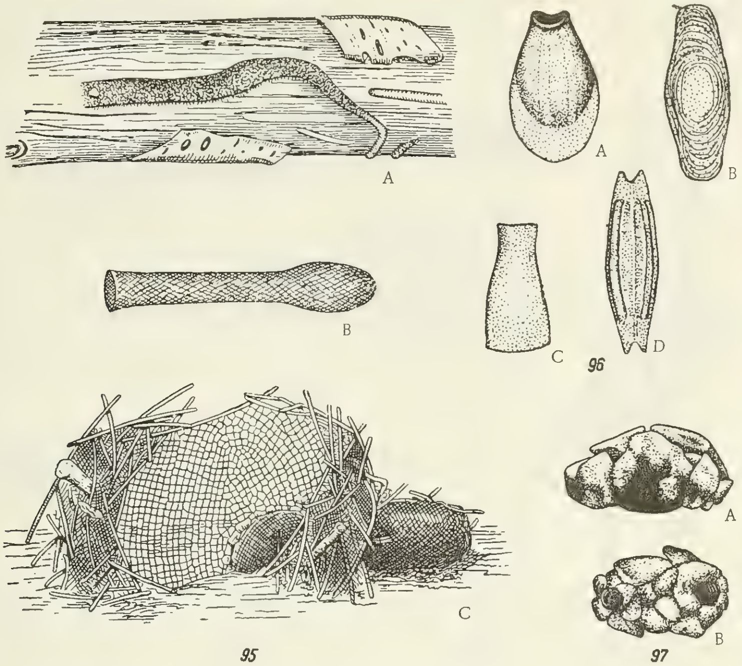
## Building activity

**Shape of the structures.** The larvae of caddis flies have well-developed spinning glands and build structures of various types, the form of which depends on the habitat and mode of life of the larvae, their type of feeding and whether they are restricted to a certain biotope. The building activity of caddis fly larvae developed in varying directions and is one of the most important factors that aid in classifying large systematic units and their biological characteristics.

In the suborder Annulipalpia only the larvae of Rhyacophilinae and Hydrobiosinae do not build structures before pupation; the larvae of Glossosomatidae and Hydroptilidae live in portable cases. However, the larvae of all other families build immovable galleries and nets serving as shelters and for the capture of prey. The simplest type of this structure is narrow, often curved gallery tubes woven by the larvae of Psychomyiidae among slimy incrustations on the bottom, on stones or wood (Figure 95, A); the structures of Philopotamidae, Stenopsychidae and Ecnomidae are similar gallery tubes longer than the larva (Figure 95, B). These larvae collect minute fragments of vegetable and animal food. The predacious larvae of the three higher families of Annulipalpia weave capturing nets which in some species of Polycentropodidae may be 12–15 cm long; the entrance to these structures forms a funnel; the larvae of Arctopsychidae and Hydropsychidae build small shelter chambers and near them screens consisting of regular quadrangular cells (Figure 95, C).

The portable cases of Hydroptilidae in the later stages are built of silk, rarely interwoven with threads of algae or covered with fine sand or diatom shells; their cases are usually flattened, and they are therefore called sacciform; their form varies; they may be elliptic, bean-shaped, flask-shaped or barrel-shaped; some cases have dorsal longitudinal ribs (Figure 96).

(67)



FIGURES 95—97. Shape of the structures of Annulipalpia:

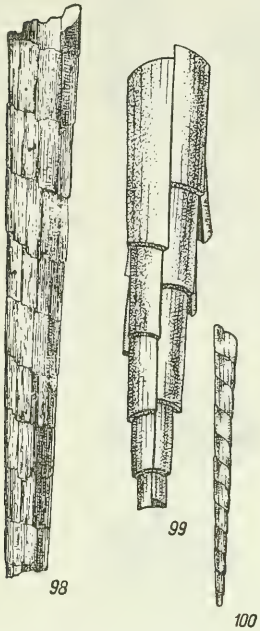
95 — galleries, chambers and nets: gallery tube of Lype reducta (A), tube and chamber of Wormaldia occipitalis (B), chamber and net of Hydropsyche angustipennis (C); 96 — sacciform cases of Hydroptilidae: Ithytrichia lamellaris (A), Agraylea multipunctata (B), Oxyethira costalis (C), Orthotrichia tetensii (D); 97 — dorsal (A) and ventral (B) of a shieldlike case of Mystrophora altaica (95, A — after Hickin, 95, B — after Nielsen, 96 — after various authors).

The cases of Glossosomatidae which are covered with sand or small stones resemble the pupal, cavelike cases of Rhyacophilidae, but the cases have a ventral wall and two equal openings at the end (Figure 97); the larva can turn around inside the tube, and each opening may serve as the anterior or posterior opening.

The portable case of the larvae of Integripalpia is usually a tube about as long as the larva or slightly longer. The tube may be cylindrical or conical, straight or curved, but it is dorsoventrally compressed. In species of Thremma, the conical tube is very short and wider anteriorly, so that
67 the case resembles the shell of Ancylus fluviatilis; in species of Helicopsyche, the tube is spirally twisted like that of a snail.

The tube of the case consists rarely only of secretion (some species of Setodes and Leptocerus). However, the outer surface of the case generally bears an often heavy outer layer firmly interwoven with the wall of the case.

The simplest type of case is a straight tube slightly tapering toward the posterior end, with a wide posterior opening. The external layer consists of fine detritus, irregularly arranged on the straight (68) tube, e. g., in the American species Phryganopsyche latipennis (see p. 162) and in the temporary cases built by many larvae of Integripalpia when they hatch from the eggs. The primitive, straight tubes with a broad posterior opening not covered with a membrane are retained in some Phryganeidae and Limnophilidae (Figures 98 and 99), but in these forms the simple tube is connected with a highly specialized structure of the outer layer which consists of spirally arranged, plant fragments. 68 The same type of case is present in Triaenodes bicolor (Leptoceridae) (Figure 100) and in some species of Mystacides.



FIGURES 98–100. Straight tubular cases of Integripalpia with a posterior opening:

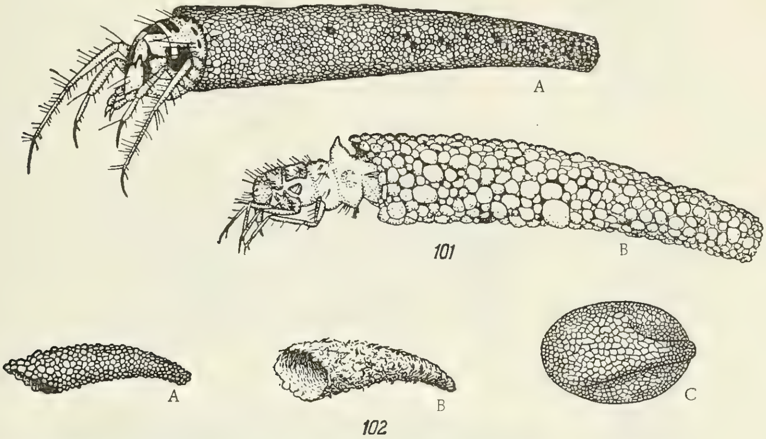
98 – Phryganea striata; 99 – Grammotaulius atomarius; 100 – Triaenodes bicolor.

The material of the outer layer may be inorganic or organic. The larva uses sand, gravel, small stones, fragments of mollusk shells, calcareous crusts of aquatic plants, or diatoms and shells of ostracods. The vegetable material are fragments of plants or stalks of plants, fine detritus or fragments of bark or wood gnawed off by the larvae; stalks of moss or algae are sometimes interwoven in the case. The longitudinal or transverse position of the material is diagnostic. Longitudinally arranged fragments are often arranged in regular spirals; plant fragments which are arranged transversely sometimes give the case a trihedral or tetrahedral form; large pieces of wood or bark give it an irregular shape.

The portable case affords mechanical protection but restricts the movements of the larvae and makes them little mobile. The case often shows perfect adaptations to certain conditions. These adaptations are expressed in the structure and shape of the case, in the quality and size of the fragments of the outer layer and in the methods of preparation and arrangement of the material on the tube. The larval cases imitate the environment of the larvae and are examples of mimicry which are sometimes perfect. The cases of larvae living among stones resemble gravel in depressions and cracks of stones, larvae living on sandy bottom have flattened cases covered with sand, and larvae living among plants have green cases covered with fragments of the same plants.

Species building conical, straight or slightly curved cases covered with sand (Figure 101) are widely distributed in stagnant water in the calm zone of lakes (Mystacides longicornis, M. nigra, Leptocerus aterrimus) or in canals, ditches, marshes and puddles in spring (Limnophilus centralis, L. vittatus).

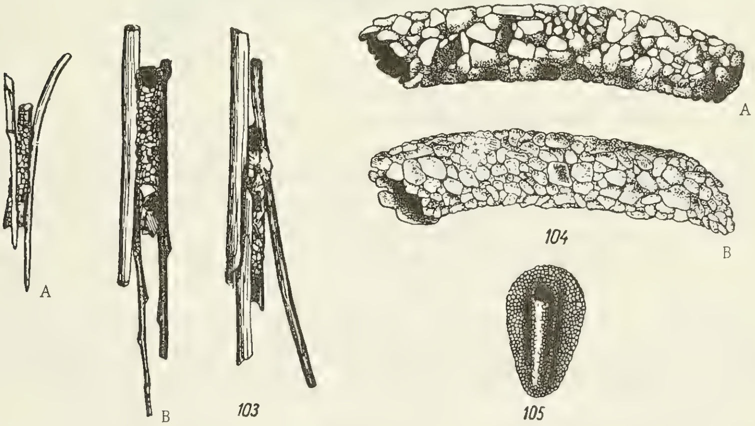
In flowing water, in brooks and streams, the conical sand cases are short, wider anteriorly, dorsoventrally compressed and streamlined 69 (Figure 102) with a flat ventral surface (Leptocerus annulicornis, L. excisus); the anterior opening of these cases is displaced ventrad and is pressed to the stone to which the larva clings with its forelegs.



FIGURES 101 and 102. Cases built of mineral particles:

101 — smooth cases of limnophilic species covered with fine sand grains (after Hickin): Mystacides longicornis (A), Limnophilus centralis (B); 102 — smooth cases of rheophilic species: Leptocerus annulicornis (A), L. excisus (B), Thremma gallicum (C — after Ulmer).

(70)



FIGURES 103—105. Cases covered with sand:

103 — cases covered with fine sand and detritus: Mystacides azurea (A), Anabolia soror (B); 104 — cases covered with coarse sand of rheophilic species: Potamophylax stellatus (A), Dicosmoecus palatus (B); 105 — case of Molanna angustata with wings.

The larvae of some Leptoceridae (Mystacides azurea) and Limnophilidae (Anabolia soror) are adapted for life at the bottom, covered with sand and detritus; these larvae build tubular cases covered laterally with conifer needles or coarse detritus consisting of thin twigs (Figure 103).

Larger species use larger sand grains or small stones (Figure 104); these cases are smooth; their posterior end is rounded or tapering, with a small opening partly covered with a membrane.

Some cases covered with fine sand (Apatania) bear large sand grains at the sides; other cases (e. g., species of Silo and Goera) are short, sand tubes with wings which consist of flat, laterally projecting stones which make the case heavy and flat. The cases of this type are also typical of inhabitants of moving water of the open surf zone of lakes.

The cases of the species of Molanna are characteristic for inhabitants of sand and sand-slime lake bottoms; they are flattened and shieldlike (Figure 105) because of the wings at the sides of the straight, conical tube. The cases imitate the sand or sand-detritus bottom so perfectly that it is sometimes difficult to recognize them even in a small aquarium and only their movements betray them. Breakers of medium strength pass over the tube; however, strong surf which is usually avoided by the larvae, which
70 concentrate in the more or less calm zones, may turn the larval case over; and the larva has to make a great effort to restore its initial position (Figure 76).

Larvae living on detritus-covered bottom build cases which are often unwieldy structures of coarse vegetable detritus (Figure 106) closely resembling the environment (Limnophilus stigma, L. flavicornis, L. rhombicus, L. politus); these species also use seeds of terrestrial plants, e. g., those of birch, parts of insects and mollusk shells, sometimes large algae, e. g., spheres of Nostoc (Figure 112, B).

Some larvae of Calamoceratidae (Ganonema extensum) cover their cases with soft wood fragments; they bore a cylindrical hollow in the fragment and live in it (Figure 107). The cases of species living in springs (Crunoecia irrorata) are covered with minute particles of detritus and have a regular tetrahedral shape (Figure 108); cases of mature larvae of Lepidostoma hirtum are similar.

In plant thickets, the larvae cut fragments of stalks and leaves and build green cases; e. g., the cases of Phryganea and Agrypnia (Figure 109), the delicate cases of Triaenodes with their spirally arranged plant fragments, the trihedral cases of Limnophilus nigriceps or L. decipiens, the leaflike cases of Nemotaulius and Glyphotaelius, the cases of Grammotaulius and other species living among plants.

The cases of Holostomis and Ironoquia dubia (which live in slow currents) are tubes covered with smoothly arranged plant fragments;
71 the cases of Halesus digitatus are covered with detritus (Figure 110) and resemble cases of Potamophylax stellatus (which are covered with sand).

**Building methods of the cases.** The structures of caddis flies
72 have been known for a long time* and have been described repeatedly, but the process of building is known only for few species.

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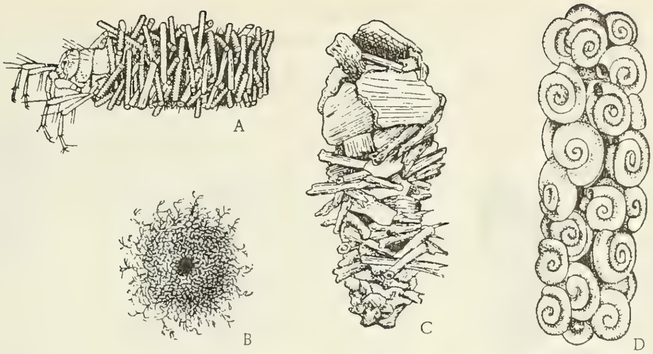
* The larvae of caddis flies were first described by Aristotle as "wooden aquatic worms."

(71)



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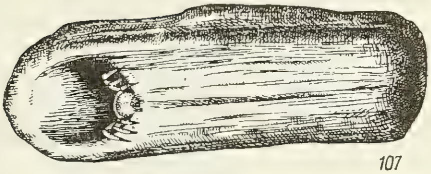

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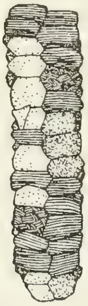

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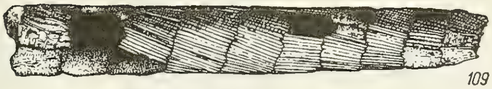

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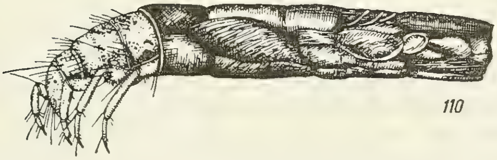

110

FIGURES 106–110. Larval cases covered with detritus, plant and animal fragments:

106 – cases of Limnophilus: L. stigma (A, B), L. flavicornis (C, D); 107 – case of Ganonema extensum (after Levanidova); 108 – case of Crunoecia irrorata (after Nielsen); 109 – case of Agrypnia obsoleta; 110 – case of Halesus digitatus (after Hickin).

The building of the case is dangerous for the larva, as it prevents it from moving and makes it conspicuous and easily accessible to predators. The larvae therefore usually build their cases when visibility is poor, i. e., under objects, in twilight or at daybreak (Phryganea). The 1st stage larvae immediately after hatching from the egg are an exception; these caseless, completely defenseless small larvae hatch with well-developed spinning glands; some species immediately begin to build the case near the egg mass; they build rapidly, in the light; the 1st stage larvae of many species are positively phototropic (Triaenodes bicolor). The main object of the larva after leaving the egg is to cover itself as rapidly as possible with a tube; the larva may then begin to feed and perfect the case. The first case is called a "temporary case"; it is a primitive structure which, as the larva grows, is gradually replaced by the strongly built definitive case, having the distinctive characteristics of the species.

(73)

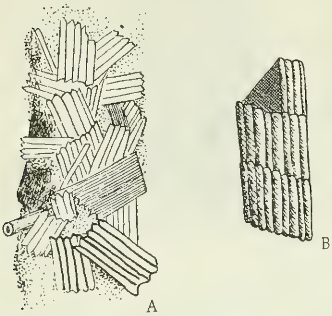

FIGURE 111. Building of the case by the larva of Phryganea grandis: case of a young larva (A), anterior margin of the case during adding process (B) (after Wesenberg-Lund)

When a mature larva is deprived of its case, it rapidly builds a temporary one; under its protection it thus adds to the case, and restores the lost one; however, the new structure is usually less perfect than the original one.

We describe below the building of tubes of several species which use plants, detritus, sand or secretion without an outer layer.

When the larvae of the large species of Phryganea (Ph. striata, Ph. grandis) hatch from the egg (Figure 80, A), they rapidly cover themselves with their temporary case which consists of detritus glued together with silk. The larvae of Ph. striata find material for their first case either on the egg mass or collect it among the vegetation which is always more or less covered with fine detritus. Before building the case, or while they bear the temporary case, the small larvae of Phryganea (Figure 80, B) are suspended in water, making clumsy swimming movements and bending the abdomen; this ability is lost as the temporary case becomes thicker.

The larva then bites off thin fragments, arranging them so that their end remains free and the case assumes a shaggy appearance; the spiral arrangement of the particles in the structures of young larvae may be weakly marked but becomes better established later (Figure 11, A, B). In the older stages, when the regular spiral has been built, the larva (Ph. grandis) weaves a net in the corner formed by the last glued bit and the anterior margin of the case; the larva thus adds an internal sheath to the case. When the silk net is ready for the addition of the outer layer, it takes a small fragment of a plant leaf; it "licks" one side of the fragment
73 with its labium, smearing it with the secretion of the spinning glands; the leaf fragment is thus placed so that its sticky side touches the woven part of the internal sheath; the larva then alternately touches the new fragment and the adjacent one with its labium and connects the fragments with a zigzag seam. The whole process takes about one minute or slightly longer.

The larvae can repair the case. If a part of the case of the larva of Phryganea grandis is cut off, the larva can reconstruct a long part of the tube in one night (Wesenberg-Lund, 1911b:78–85).

When the larvae of Phryganeidae, which live in tubes with a posterior opening are removed from the case, they return to it and assume their initial position; larvae of Agrypnia pagetana Curt. forced to leave the case return to it rapidly and repeatedly.

Larvae of species of Limnophilidae build cases from live plants, including the genera Glyphotaelius and Nemotaulius (G. pellucidus, N. punctatolineatus). The cases of these species are straight tubes which are dorsally and ventrally covered with large, laterally projecting plant fragments; these fragments are arranged and cut in such a manner that the case looks like the leaf of a plant; the larvae build their cases of the leaves of Potamogeton natans, but they also use other plants. The type of the structure changes with age. The larvae of the early stages build the outer layer of the upper and lower sides of the case from narrow, thin fragments of sedge which are placed transversely (Figure 112, A). As the larvae grow, they use fragments of large leaves; the anterior margin of a fragment is convex and its posterior margin slightly oval or straight; the fragments are arranged alternately, either on the dorsal or on the ventral side at the anterior margin of the case. The part of the case with broad fragments increases gradually, and the empty case of the younger stage remains attached posteriorly (Figure 112, C); it falls off after some time and the case of Nemotaulius acquires its definite shape which is characteristic for the larvae of older stages (Figure 112, D). The broad fragments on the dorsal and ventral surface are contiguous at the sides and between the margins, and the lateral wall of the tube remains a free space. The cases lose their green color toward autumn: the larvae move to the bottom and new fragments of fallen leaves are added; the case becomes dark, like other animals living on the detritus-covered bottom.

(74)

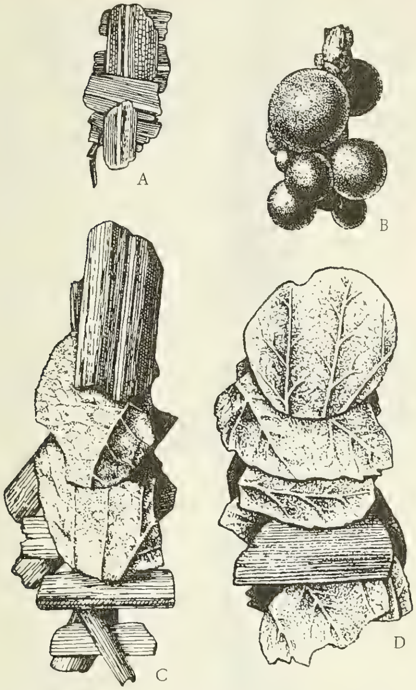

FIGURE 112. Construction of the case of Nemotaulius punctatolineatus: case of a young larva (A), case covered with spheres of Nostoc (B), case of a 4-stage larva with remains of the case of the preceding stage (C), case of a full-grown larva, dorsal (D)

74 An example of cases built of detritus are those of the larvae of Limnophilus, e.g., L. flavicornis, L. politus, L, rhombicus, L. marmoratus and partly also of those of L. nigriceps; the larvae of this species build their cases from detritus in the early stages and, in later stages, they build them from fragments of live plants. The freshly hatched larvae of L. nigriceps leave the egg mass and build a temporary case; a ring around the first abdominal segments is built first; it is continued posteriorly and the whole abdomen of the larva is gradually covered with the case, which is irregularly covered with detritus (Figure 113); only then does the larva begin to feed.

When a mature larva of L. flavicornis is removed from the case, it first crawls about restlessly for some time, and then builds a temporary case. This consists of several thin bands around the body which are connected with each other at some points. The material of the outer layer is glued to the bands irregularly; the larva does not use large particles and does not prepare them; it usually uses ready, soft material. The definite case is completely different; the sheath is thick, forming a strong tube from which the particles of the outer layer can be removed without damage to the tube. The larva arranges the fragments in the form of a thick, continuous layer. It usually builds the case from pieces of reeds and cane; and it prefers spruce needles to pine needles.

(75)

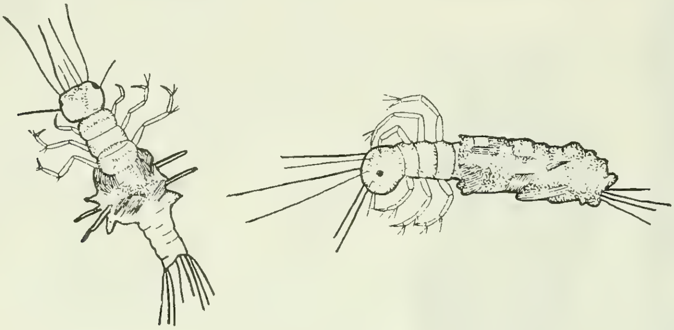

FIGURE 113. 1st stage larvae of Limnophilus nigriceps in temporary cases

Building takes place as follows: the larva holds a fragment of detritus with its fore and midlegs; it places the fragment near the anterior margin of the case, then it smears the fragment at the inner and outer sides with the secretion of the spinning glands; at the same time it prolongs the secretion-made tube by a length corresponding to that of the fragment. The time used for building shows that the building of the definite case is more complex than that of the temporary one: under experimental conditions, the
75 larva of L. flavicornis needs 6–8 hours to build a temporary case, but it needs 8–10 days to build the definite case. When this is ready, the larva turns about inside the case, bites off the temporary case and weaves the membrane of the posterior end which has a round opening in the middle; the larva then resumes its normal position (Gorter, 1931).

The building of the case from sand was studied in detail in Molanna angustata Curt. (Dembowsky, 1923, 1933). The case of Molanna is complex, consisting of a tube, a broad anterior hood and wings (Figure 114, B).

When removed from its case, the larva of Molanna crawls restlessly on the bottom for some time and then begins to dig itself into the sand, stirring it with movements of head and forelegs; gradually the larva buries itself in the sand. It then turns on its back and by movements of the abdomen throws particles of sand to the anterior part of the body; it catches them with the legs, smears them with secretion (see spinning glands in Figure 114, A) and makes a coil of threads in which many particles are entangled. When this coil is sufficiently large, it is used as a supporting base to which the first ring of the new case is attached (Figure 114, C).

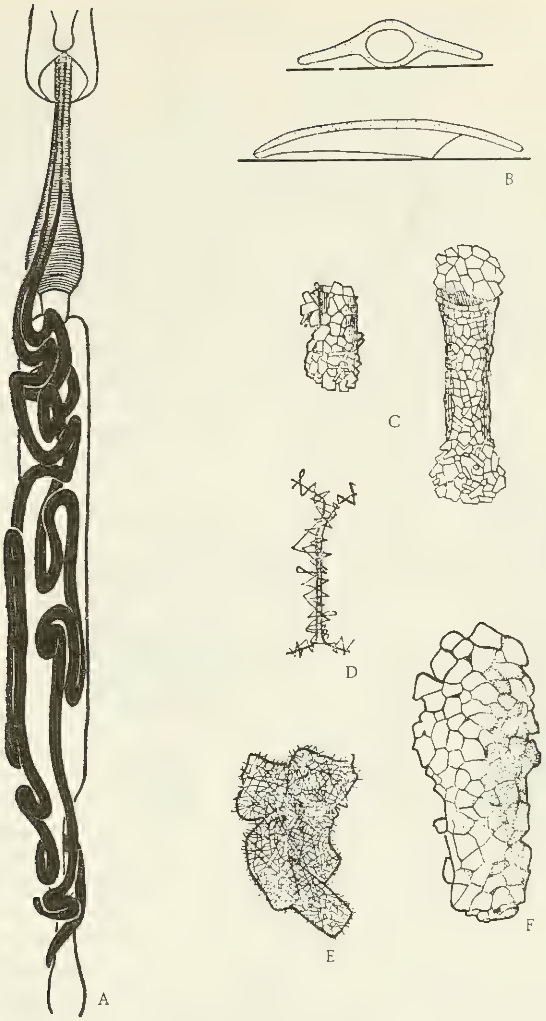

FIGURE 114. Building of the case of Molanna angustata: spinning glands (A), diagram of the case of Molanna, transverse and longitudinal sections (B), supporting base, temporary case and first part of the construction of the tube of the definite case (C), zigzag suture connecting the sand particles (D), a piece of felt of the inner surface of the tube (E), completed tube and the beginning of the construction of the anterior hood (F) (A – after Zarechnaya, B–F – after Dembovskii)

The larva then begins to build the tube, making a narrow ring of sand grains around its body which forms the anterior margin, and gradually builds the tube on this ring. During the building, the larva projects from the anterior opening of the case; it takes a particle, turns it in various directions, but does not smear it with secretion; it only examines the particle. If it is unsuitable, it is discarded. The larva may sometimes

discard 4 or 5 particles until it finds a suitable one. The selected particle is first placed at the anterior margin at four or five different points; while a suitable position is searched for, the particle is repeatedly turned before being glued. When the position has been found, the larva touches the
76 particle and the neighboring particle alternately with the opening of the spinning glands so that a zigzag suture results (Figure 114, D) gluing the new particle to 2 or 3 neighboring ones. Cracks and hollows between the particles are sealed with silk threads. The construction progresses rapidly; the old part is added to and repaired, and the larva repeatedly retracts into the tube to strengthen the connections between previously laid particles. The net of threads connecting the sand particles becomes gradually denser and thicker, producing a felt (Figure 114, E) which forms the soft inner lining protecting the larva from contact with the sand particles. If a sand particle is attached to the anterior margin of the case, the selection of a particle takes about 9 seconds; the licking of it about 10 seconds, and gluing a particle with a zigzag suture 30 seconds. If the building is interrupted (e. g., if the previous work has to be repaired) the building of a case takes longer.

The posterior end of the tube, which was attached to the supporting base, is removed from this when the tube is completed. The larva turns about inside the tube and cuts the threads not far from the posterior end of the tube; together with the supporting base, the larva also cuts off the small,
77 first part of the tube. It examines the posterior opening of the case, straightens it, and strengthens it with silk threads.

After an interval the larva begins to build the anterior hood (Figure 114, F) and the lateral wings, using the same process of selecting, examining and connecting the particles; the larva projects from the case almost its whole length and bends posteriorly during this activity. It is impossible to build well under these conditions; the particles are loosely connected to the margin of the wings, and the larva cannot attach wings to the posterior end of the case. It prolongs the tube and adds the wings, and then bites off the posterior part of the tube without wings, building the wings along the whole case.

The larva of Molanna angustata can rebuild the anterior part of the case if this is removed, rebuild wings, seal a cut in the anterior hood, repair holes in the middle of the case, but is unable to repair damage in the posterior end of the tube (Dembowsky, 1933:271–292).

Cases made of secretion are built by the larvae of Setodes in the Integripalpia; such cases are built by a number of species of Hydroptilidae in the Annulipalpia.

When a larva of Setodes (Leptoceridae) is removed from its case, it begins to build a new case, like the other Integripalpia, by forming a supporting base of detritus and secretion; this base is loosely attached by some silk threads to the ventral side of the 1st abdominal segment; the base is kept in position by the fore and midlegs and by the end of the curved abdomen. The larva hangs from a plant with its swimming hind legs; the
78 fore and midlegs do not have to support the body and are free to be used for building. When the supporting base is completed, the larva moves it to the dorsal side of the 1st abdominal segment (at the point of the mediodorsal process) with its mouthparts, legs and the anal legs. It then lays down a

silk thread for the first half ring of the temporary case; further threads are added, and the larva thus builds the other side of the half ring, so that a full ring is formed (Figure 115, B). The larva builds a temporary case from the anterior margin, covering it with numerous small particles of detritus; it rapidly covers itself with a temporary case and the use of detritus saves the secretion of the spinning glands. When the temporary case is about half as long as its body, the larva turns about inside the case and bites off a large part of the posterior part of the tube; it then begins to build its definite case (Figure 115, C), which consists of secretion without detritus; this is begun at the anterior margin of the temporary case. As the case consists only of silk, its building is slow and may take eight days or more (sometimes even as long as a month), i. e., much longer than in species covering their case with other material (Carasso and Maillet, 1954).

(77)

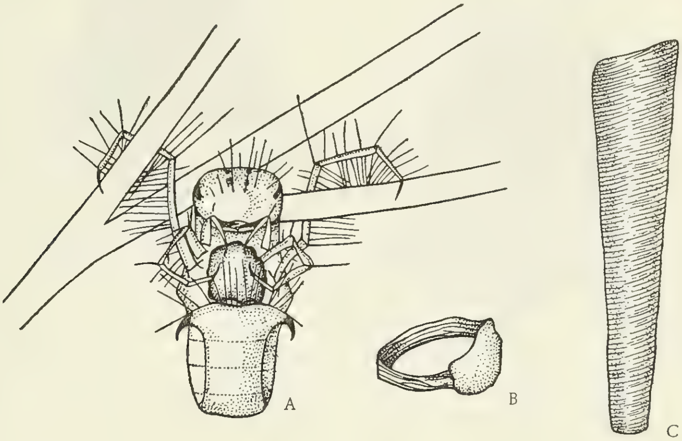

FIGURE 115. Building of the case of Setodes sp.: posture of larva and building of supporting base (A), supporting ring (B), completed case (C) (after Carasso and Maillet)

The larva of Oxyethira (Hydroptilidae)* begins to build its case at the 5th stage; it begins by making a supporting ring of detritus and silk threads (Figure 116); this ring, which is loosely attached to an alga, is the initial structure which replaces the supporting base of Integripalpia and is the first stage of the building of the bottle-shaped case. The neck of the bottle is the anterior margin of the ring, the bottle-shaped part of the case is the posterior part; the detritus on the ring gradually disappears, but its traces remain visible for some time.

The larvae of Agraylea build the case among algae; they select a straight filament as base for the case. The larva bites off a part of the filament and attaches its ends to the margin of the base so that the filament forms a bow; the space between the filament and the base is filled with silk threads which also envelop the curved filament. The larva then builds the two laterally connected valves of the anterior half of the case, whose inner walls are then strengthened with a dense mesh of silk (Figure 117); the

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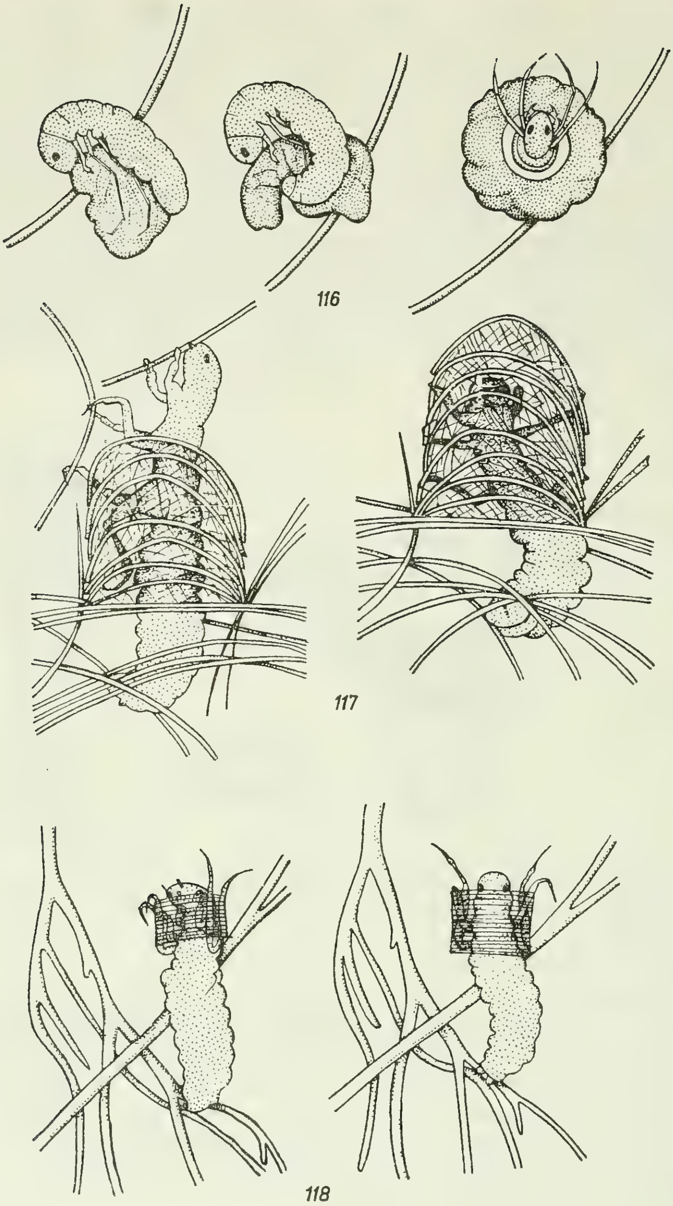
* The structures of Hydroptilidae are described after Nielsen (1948:145–163).

(79)



FIGURES 116–118. Building of cases of the larvae of Hydroptilidae (after Nielsen):

116 – weaving of supporting ring of the larva of Oxyethira costalis; 117 – larva of Agraylea multipunctata during weaving of case; 118 – beginning of weaving of case of Orthotrichia tetensii.

larva twists its body like a corkscrew during the work and weaves an inner layer on both valves. The second half of the case is built by the same method.

The larva of Orthotrichia tetensii weaves a ring of secretion around the anterior part of its body as a supporting structure and attaches this ring to the filament of an alga (Figure 118). The larva then gradually completes the case with its five dorsal ribs and its weak ventral suture.

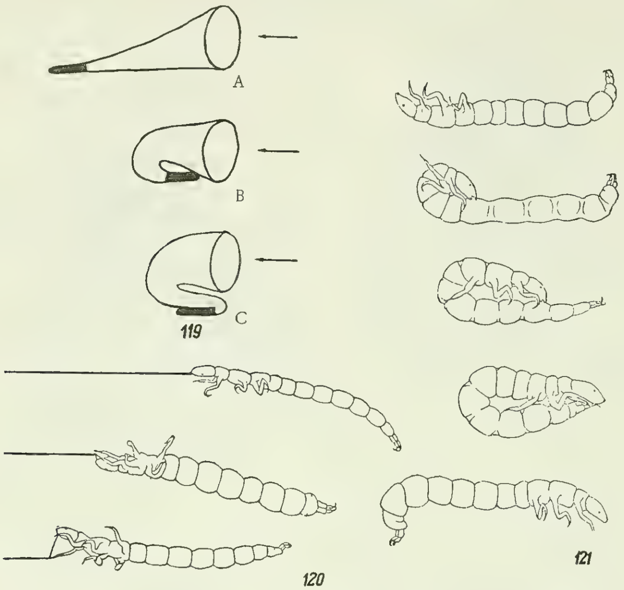
**Weaving of nets.** The building of primitive tubular nets attached to stones has been little studied. The larva of Wormaldia occipitalis begins the weaving of its short tubular nets by drawing longitudinal threads and then interweaving them with transverse threads; this is 80 reversed when the larva repairs the nets: it first restores the transverse, then the longitudinal threads (Wormaldia, Polycentropus).

The capturing funnel of Plectorocnemia conspersa is more complicated, forming a large structure, 5–10 cm long, in the form of a broad, posteriorly rounded funnel; the opening of the funnel, which is directed against the current, is 4–5 cm wide; the entrance of the net is connected by threads in various directions from the anterior margin to stones or stalks of moss. There is an opening at about the posterior third of the funnel into a tube which is about 5 mm wide and almost as long as the net; almost the whole length of the tube is attached to a hard substrate, e. g., the bottom, stones or stalks of plants; the tube is open, slightly funnel-shaped and loosely attached to plants or stones with several threads; the larva usually remains in the basal part of the tube with its head toward the net; the larva is a predator which catches small and large animals, especially larvae of its own species of almost its own size (Nielsen, 1942:410–412).

The capturing net of Neureclipsis bimaculata (Polycentropodidae) is very complicated. The building of this net was studied under experimental conditions. The dwelling chamber of the net of a mature larva is not longer (or slightly longer) than the larva; the capturing funnel is very large; in well-developed mature larvae and under favorable conditions it may be 20 cm long, and sometimes even longer (Brickenstein, 1955).

The dwelling chamber is a simple tube; it is arranged in various directions, depending on the environment; the larva selects a place convenient for attaching the threads which fasten the tube to the substrate; the entrance to the capturing funnel is always directed against the current; the funnel is thus a direct continuation of the dwelling tube (Figure 119, A) or it is coiled once or twice at the base (Figure 119, B, C).

The building begins from the dwelling chamber; this consists of two activities: finding a suitable place and weaving the tube. The searching activities consist of two types of movements: 1) undulating movements, during which the larva remains in its place and moves head and thorax from side to side, examining the surrounding objects; 2) sharp, forward-jumping movements. When it reaches a new place, the larva again makes undulating movements; it places the dwelling chamber in a hollow which is sometimes covered, or in a crack between two surfaces; if there is no better place, it builds the dwelling chamber on a level surface. The tube is woven by movements of head, legs and body. The larva attaches its threads in various directions, drawing them longitudinally upward or downward (Figure 120); the threads may be of two types: either spun by the spinning glands and accessory glands of the head, or by the same secretion together with secretion of the pedal glands. When the outline of the tube is complete, the larva strengthens it inside, adding to the thickness of the walls; it turns 81 forward and backward, upward and downward inside the case during the weaving (Figure 121). A well-fed larva spends about one hour in search of a location for the tube when the speed of the current is 0.04–0.07 m/sec; it needs about 6 hours for the weaving of the tube; the case is usually built in the evening, night or early morning, between 5 p.m. and 5 a.m. After completion of the dwelling tube the larva rests for several hours.



FIGURES 119–121. Construction of a net by the larva of Neureclipsis bimaculata (after Brickenstein):

119 – diagram of the capturing funnel, A – straight, B – coiled, C – coiled twice; 120 – spinning a silk thread; 121 – the larva turns about and cleans itself.

The weaving of the capturing funnel consists of a complicated series of movements for the drawing of the longitudinal threads (dark larva in Figure 122) and for their interweaving with the transverse threads (light larva in Figure 122). After completing the skeleton of the thin-walled, coarse-meshed, funnel-shaped net, the larva thickens the walls of the chamber, adding new layers of threads on top of each other to the inner side; during this process the larva changes the initial, relatively simple funnel; it increases its breadth in some places, and narrows it in other places, forming curves and convexities; Figure 123 illustrates the intermediate stage of the weaving of the funnel and a completed net of over 20 cm length.

(82)

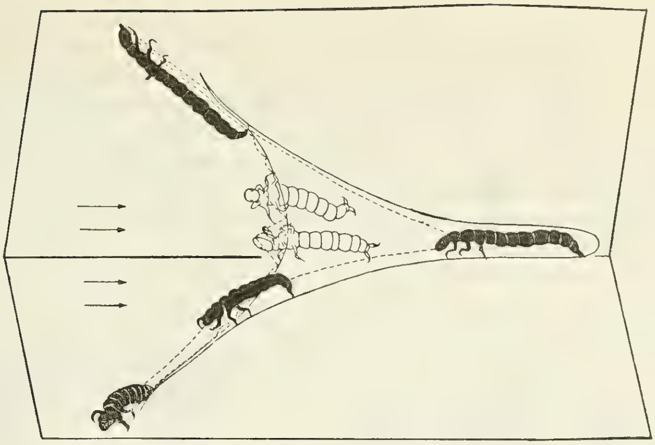


FIGURE 122. Weaving of capturing funnel of the larva of Neureclipsis bimaculata; the black larva indicates weaving of longitudinal threads and the light larva weaving of transverse threads (after Brickenstein)

(83)

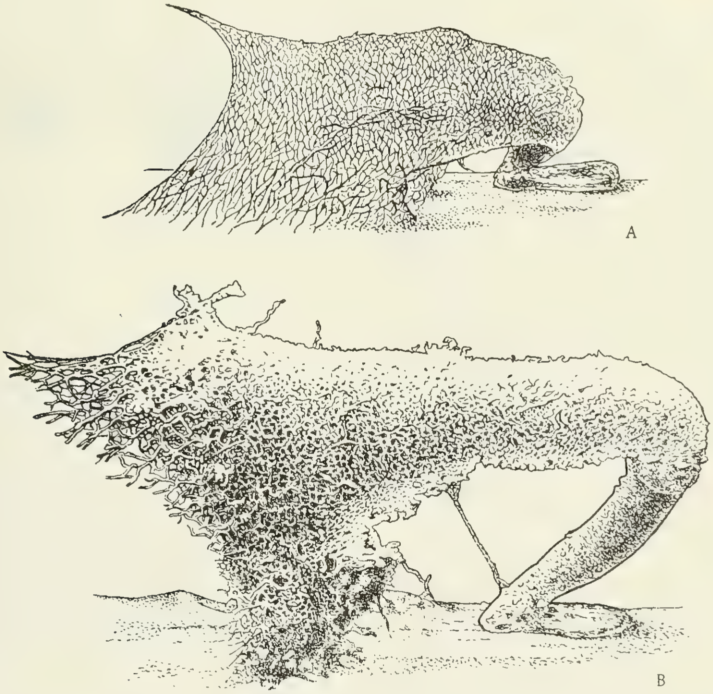
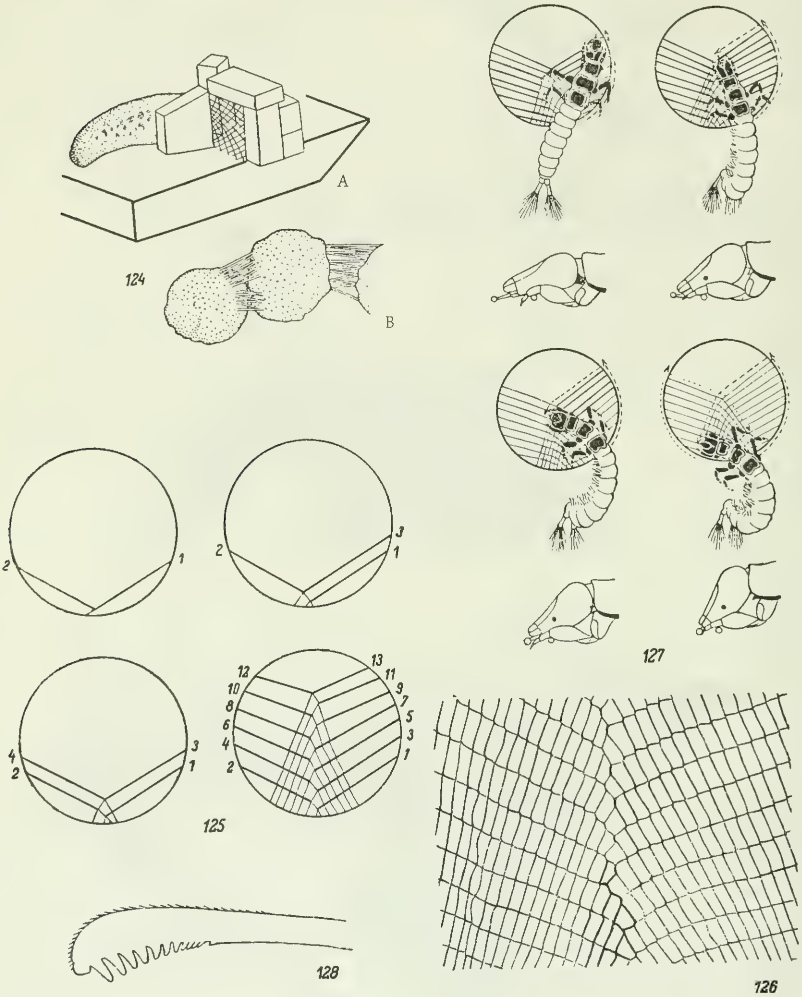


FIGURE 123. Capturing net of Neureclipsis bimaculata (not complete) (A), and complete (B) (after Brickenstein)

The building of the capturing net takes about 3 days (with interruptions).
As mentioned above, the larva builds in the evening or at the end of the night
and early in the morning; it ceases its activity during the day; one of the
mature larvae in the experimental pool of C. Brickenstein built its net
82 according to the following schedule (current 0.05 m/sec): 7 August 1952
from 20.20 to 2.00; 8 August from 2.05 to 4.20 and from 22.00 to 23.40;
9 August from 5.00 to 6.00 and from 21.08 to 23.12; 10 August from 2.20
to 6.09; on the last date, the net was 29 cm long and the funnel 13 cm wide.
The whole construction thus took about 12 hours.

(84)



FIGURES 124–128. Construction of the capturing net of Hydropsyche angustipennis (after Sattler):

124 – model of dwelling chamber, entrance hall and net (A), connected sand particles of dwelling chamber (B); 125 – diagram of the weaving plan of net; 126 – part of capturing net; 127 – larva weaving its net; 128 – pectinate hair of anterior tuft of the labrum of the larva.

The threads lose elasticity several days after completion of the nets, and have to be replaced. The larva thus continues to build at night during the whole functional period of the net, without increasing the length of the net; it repairs damage and lays new threads on the inside, beginning from the anterior margin of the dwelling chamber and continuing toward the entrance to the funnel. This activity of the larva ensures the elasticity of the net during the whole time of its existence (about 6 weeks); if the outer wall of the net wears off, new walls of the funnel are constantly woven on the outer surface.

While the funnel is still incomplete, plankton falls on the net and is caught by the larva; this provides food during the whole weaving process. The larva builds a capturing net from its first stage and continues to do so during its whole later development; the net of a freshly hatched 1st stage larva is 4–6 mm long (Brickenstein, 1955:6–44).

Sattler observed the weaving of the nets of the larvae of Hydropsyche angustipennis and of three other species (H. instabilis, H. pellucidula, H. fulvipes) in nature and in an experimental vessel with stones at the bottom (Figure 179) and with an artificial water current; the process of weaving could be observed distinctly through the walls of the vessel (Sattler, 1958). These observations were repeated many times, but no
83 difference was found between the nets of the species observed. Sattler's observations were made on mature larvae.

The net of Hydropsyche consists of a dwelling chamber, a capturing net and an entrance "hall" to each (Figure 124, A). The larva selects a suitable place for the dwelling chamber in a hollow among stones; it then attaches the supporting threads which determine the length, width and height of the chamber; the length of the case is determined by the length of the larva; the width and height of the case are determined by threads drawn by the larva perpendicular to its body, near its upper and lower level, at the ends of the chamber; the weaving of the dwelling chamber begins from the front; it is woven alternately from the anterior or posterior end; the weaving ends in the middle of the case, where the anterior and posterior parts of the net meet; the walls of the chamber are covered on the outside with minute sand grains connected by zigzag sutures (Figure 124, B). After completion of the dwelling chamber, the larva weaves the entrance hall, enclosing a small space near the chamber by dome-shaped or less regularly built walls of sand grains, which are more or less strongly glued together.

The weaving of the capturing net begins with the preparation of a frame; the larva may use objects in the vicinity for this, such as stones or twigs; if these are not available, the larva weaves a round or less regular frame;
84 this is attached to surrounding objects, and its margins are framed with leaflets or detritus. The weaving of the net is rapid and is performed in a strictly definite order. Unlike the larva of Neureclipsis which runs from one side to the other, the larva of Hydropsyche weaves its small
85 net while it remains in one place. The larva then occupies a position in the middle, near the base of the frame; it begins weaving from the bottom; it attaches the 1st thread to the circumference of the frame and draws it to a point near the middle of the base (Figure 125); the 2nd thread is placed in a similar direction and sequence, but from the other side; it is glued to the 1st thread at their intersection; both threads become curved at the

intersection; the 3rd thread is drawn almost parallel to the 1st and is glued near the base, next to the 2nd thread; the 4th, 5th and following threads are drawn in the same manner; this results in a net of oblong quadrangular meshes, with a median zigzag line dividing the net into a right and left half with almost parallel threads in two directions (Figure 126); Sattler (1958:157) states that published drawings showing the net with regular quadrangular cells in one direction are wrong. The frame is not always almost circular in nature; its cells are not so regular, and the intervals between the threads attached to the frame increase from bottom to top, so that the threads are not parallel.

Drawing a free part of thread and fastening it to the intersection with the threads drawn before requires two types of activity (Figure 127); in the first type the larva is extended, the head is directed forward, the mid- and hind legs are widely separated and the forelegs are extended along the ventral margin of the head; in the second type (made more complicated by interruptions for attaching the threads), the body of the larva is curved, the head is inclined downward and the mid- and hind legs are held close to the body; the distance between the stretched thread and the next thread becomes smaller (see Figure 126).

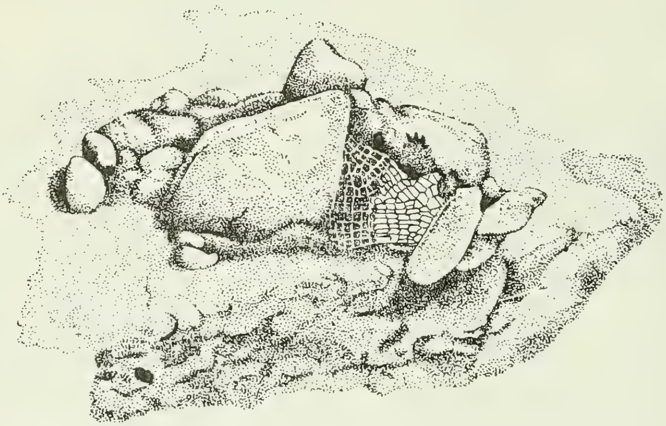


FIGURE 129. Capturing net of the larva of Hydropsyche angustipennis (after Sattler)

86 When the current is slow, the net is perpendicular to the current; when the current is rapid, the net is placed at an angle to the current; in an experimental vessel, at a current of 0.1–0.15 m/sec the nets were built perpendicular to the current; Sattler confirmed the rule of Wesenberg-Lund* in a brook with a more rapid current; he found 23 nets situated at an angle to the current.

The net is built rapidly; a full-grown larva completes the net without disturbance in 7–8 minutes! If the net is torn during the weaving, the larva does not repair it but begins to build a new net which is usually less perfect

* A rule on the oblique position of nets in the current (Wesenberg-Lund, 1911a:34; 1943:204–205).

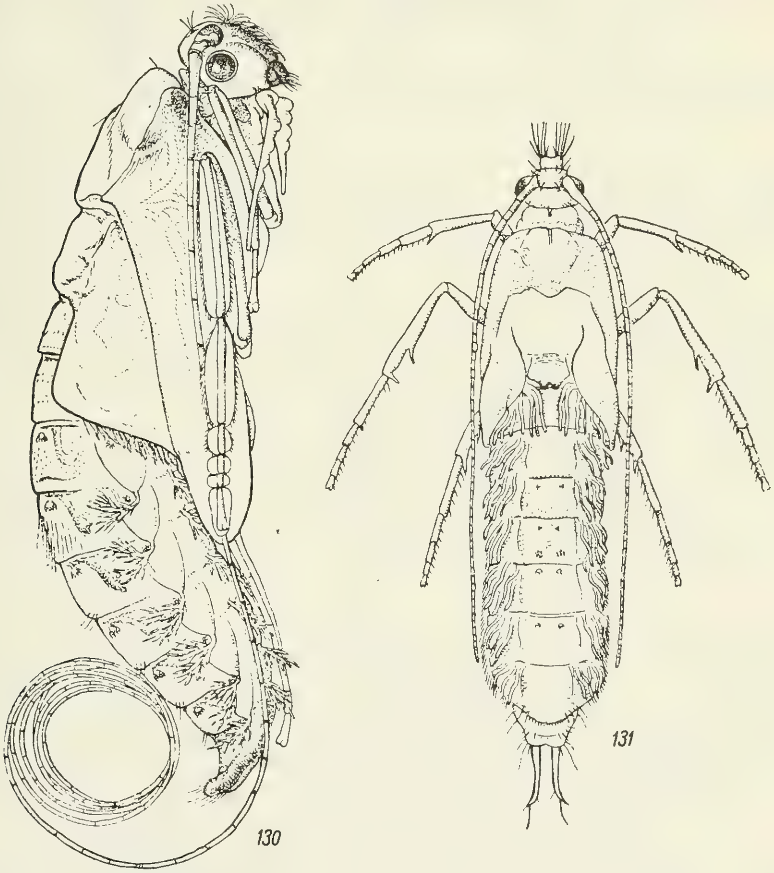
than the first. The larva cleans the meshes of the net; the threads always appear brilliant silvery; the net is cleaned with the brushes on the labrum, the pectinate form of the hairs of the brush (Figure 128) assists in the cleaning. The general appearance of the capturing net of the full-grown larva of *Hydropsyche* is illustrated in Figure 129.

## PUPA

### General description

The pupa of Trichoptera (Figures 130 and 131) are free or exarate pupae (pupa libera); the appendages of head and thorax are free and articulate with the body only at the base. Unlike many free pupae, the pupa of caddis flies is very active, making movements both inside the pupal case and when emerging from it; the pupa swims for some time and then crawls out of the water.

(87)



FIGURES 130 and 131. General appearance of pupa:

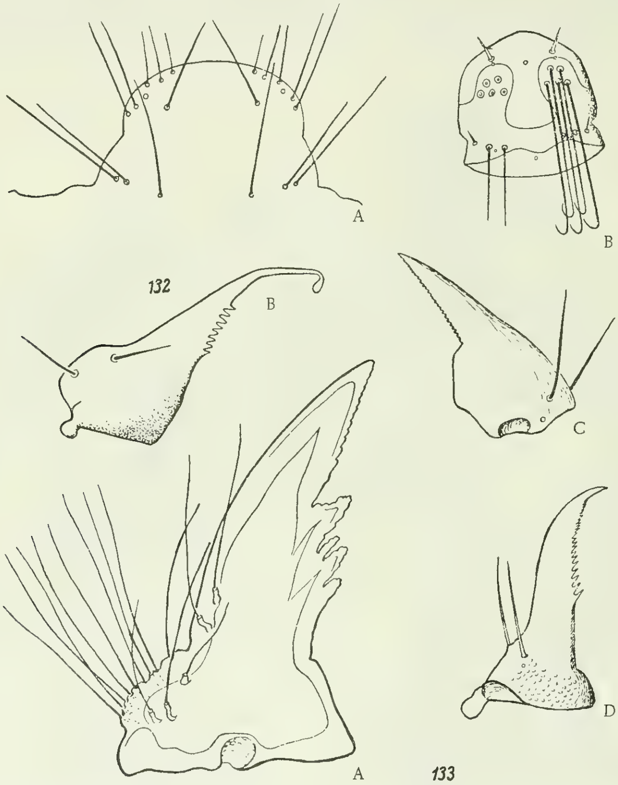
130 — *Amphipsyche proluta*, lateral (Annulipalpia); 131 — *Limnophilus flavicornis*, dorsal (Integripalpia) (after Ulmer).

The pupa resembles the adult to some extent; however, the pupa retains some characters of the larva (e. g., gills) and has specific organs present in the pupal stage; such are the clinging and cleaning apparatus of the pupa, its swimming organs and the labrum and mandible, which have a different function from those of the larva.

## Morphology

**Head.** The head is small, broad and orthognathous; its dorsal side is convex. There are large eyes on the sides. The antennae are as long as in the imago and are directed posteriorly, along the body; if the antennae are longer than the body, their ends are coiled around the last abdominal segments.

(88)



FIGURES 132 and 133. 1st-stage larvae of Limnophilus nigriceps in temporary cases:

132 – Anteclypeus and labrum of Mystrophora altaica (A), and Potamophylax nigricornis (B); 133 – mandible of Macronema radiatum: dorsal view of left mandible (A), ventral view of right mandible of Odontocerum albicorne (B), dorsal view of right mandible of Potamophylax nigricornis (C), dorsal view of left mandible of Sericostoma pedemontanum (D) (132, B, 133, B–D – after Nielsen).

The anterior margin of the frontoclypeus bears 3 setae at each side and 3 setae at the frontal suture; the anterior weakly sclerotized part of the frontoclypeus projects above the margin of the epicranium and is separated from the other part of the frontoclypeus by a deep groove; this part is usually considered to correspond to the anteclypeus of the larva (Nielsen, 1942:314).

The labrum of the pupa is contiguous with the anteclypeus (Figure 132); it is narrower but longer than in the larva, and its dorsal surface is weakly
87 sclerotized; its surface bears 6 setae on each side, sometimes only 3–5 setae; except seta 1 at the anterior margin, the setae are thick, projecting anteriorly and sometimes long and hooked; at the end the setae of the labrum are used to clean the anterior openings of the pupal case.

With rare exceptions,* the mandibles (Figure 133) are well developed and sclerotized; they consist of a broad basal part and narrow distal part; they
88 are filiform at the apex in Psychomyiidae and Odontoceridae; the blade of the mandible is finely serrated, often with several large or small teeth; the outer side of the basal part of the mandibles bears 2 primary setae which are accompanied by numerous secondary setae in some species. The mandibles have two functions: they clean the anterior opening of the pupal shelter in some species and break the wall of the shelter when the pupa emerges.

Maxillae and labium are not sclerotized and nonfunctional in the pupa; the maxillary and labial palps of the pupa resemble those of the imago in form and number of segments.

**Thorax.** The prothorax of the pupa is much smaller than the mesothorax and metathorax, which contain the developing musculature of the wings.
89 The wings lie in transparent wing sheaths at the sides of the pupa and partly on its ventral side, where the wing sheaths of both sides come in contact or slightly overlap.

The hind and midlegs are long; the forelegs are much shorter; the spurs on the tibiae form sheaths in which the spurs of the imago develop; the spurs of the pupa are thicker and relatively shorter than those of the imago; The tarsus has 5 segments; the pretarsus of most forms bears 2 short pointed appendages: the claws of the pupa (Figures 134 and 135); the midlegs are rarely natatorial; their tarsal segments are long and broad, bearing swimming combs dorsally and ventrally which consist of a row of large, dense setae; the swimming setae are less numerous in some forms on the hind legs, sometimes also on the forelegs. Species pupating near the waterline or on land among moss or detritus do not have swimming setae.

**Abdomen.** The abdomen of the pupa resembles that of the imago, but it is longer and thicker; its 9 segments are distinct; the 10th segment is small and fused with the 9th. The pupa retains the larval lateral line and the gills which are present, with rare exceptions, in the pupae of all Integripalpia; gills are also present in the pupae of some Annulipalpia (Polycentropodidae and Hydropsychidae). The pupal gills have usually the same structure as the larval gills; in some groups of Annulipalpia gills are present in the larvae and absent in the pupae (Rhyacophila); in other groups (Polycentropodidae) the larvae do not have gills, but gills appear in the pupae.

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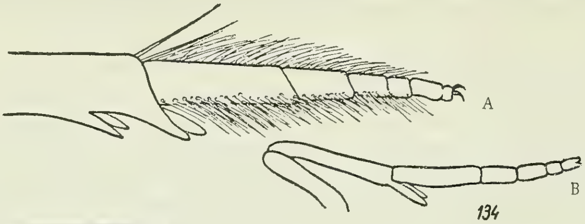
* In the family Phryganeidae, e.g., in the pupae of Holostomis, Oligostomis and Hagenella, the mandibles are reduced as in the imagines and are short, nonfunctional membranous lobes; these species pupate in tubular shelters, the anterior end of which is not covered with a woven membrane but is covered with parts of plants; these pupae emerge easily through this opening without the help of the mandibles (Wiggins, 1960:449–452).



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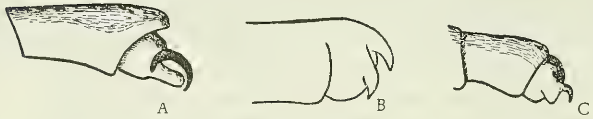

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FIGURES 134 and 135. End of midleg of pupa (tarsus and pretarsus):

134 — distal end of tibia, tarsus and pretarsus of Mystrophora altaica (A); same of Beraea maurus (B) (after Thienemann); 135 — 5th tarsal segment and claw segment of Rhyacophila septentrionis (A), Phryganea striata (B), Crunoecia irrorata (C) (A, C — after Nielsen).

(90)

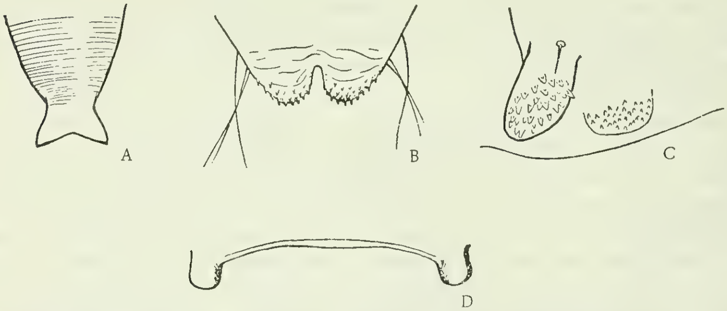
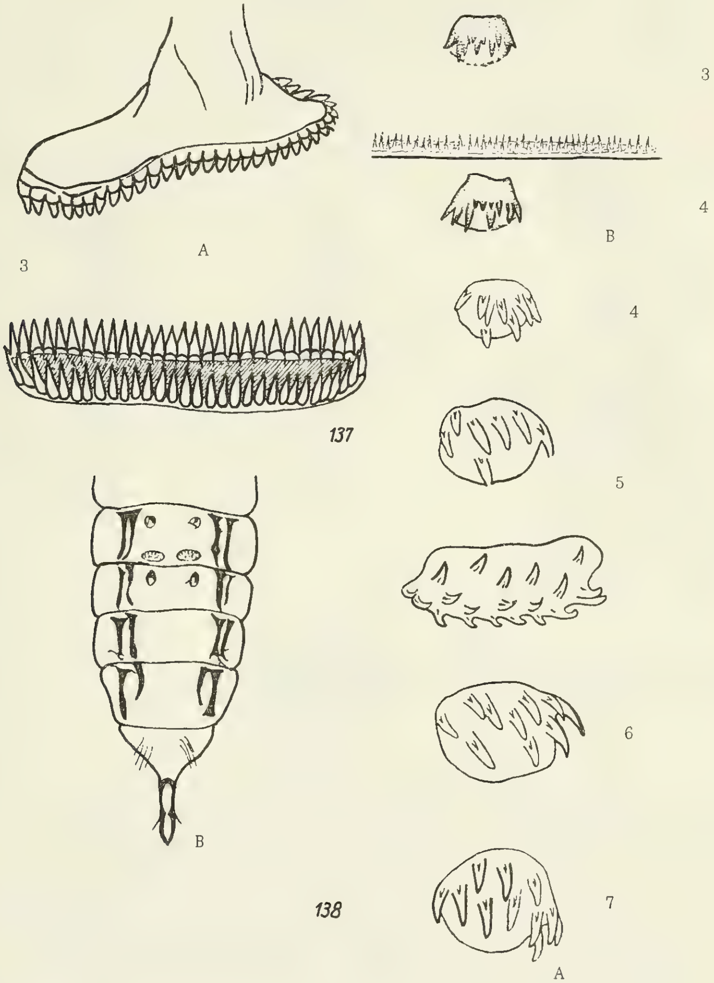


FIGURE 136. Dorsal process of the 1st abdominal segment of Integripalpia: Phryganea striata (A — after Ulmer), Glyphotaelius pellucidus (B — after Ulmer), Leptocerus aterrimus (C), Crunoecia irrorata (D — after Nielsen)

In the Integripalpia, the lateral line of the pupa is present on fewer segments than in the larva; for example, in the Phryganeidae, the lateral line of the larva begins on the 3rd segment but it begins on the 4th segment of the pupa; in the Limnophilidae, the lateral line of the larva begins on the 3rd segment and in the pupa on the 5th; it begins on the 3rd segment in the 90 larva of Goeridae and on the 4th or 5th segment in the pupa. The lateral line of the pupa bears a fringe of dense and long setae which is well developed in many species.

In pupae of Integripalpia, enclosed in narrow tubes, the dorsal side of the 1st abdominal segment bears 1 or 2 processes with spines or crotchets at the apex (Figure 136); these tubercles are the clinging organ of the pupa with which it anchors itself; this enables it to make rhythmic movements driving the water through the tube; the function of the dorsal processes of the 1st abdominal segment of the pupa is thus analogous to that of the dorsal and lateral papillae of the 1st abdominal segment of the larva. The dorsal process of Phryganeidae (Figure 136, A) is a high tubercle with apical spines; in the Limnophilidae, it is a saddle-shaped tubercle (Figure 136, B); in the Leptoceridae, it forms small tubercles at the posterior angles of the segment (Figure 136, C); in the Lepidostomatidae it forms two tubercles at the sides of the segment (Figure 136, D). Small spines or points are present at the apex of the processes.

(91)



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FIGURES 137 and 138. Clinging apparatus of the abdomen of the pupa:

137 — Annulipalpia: Hydropsyche nevae, presegmental and postsegmental sclerites of segment 3 (A); Macronema radiatum, presegmental sclerites of segments 3 and 4 and part of the postsegmental plate of segment 3 (B); 138 — Integripalpia (after Thienemann): Agrypnia pagetana (A); Leptocerus senilis (B).

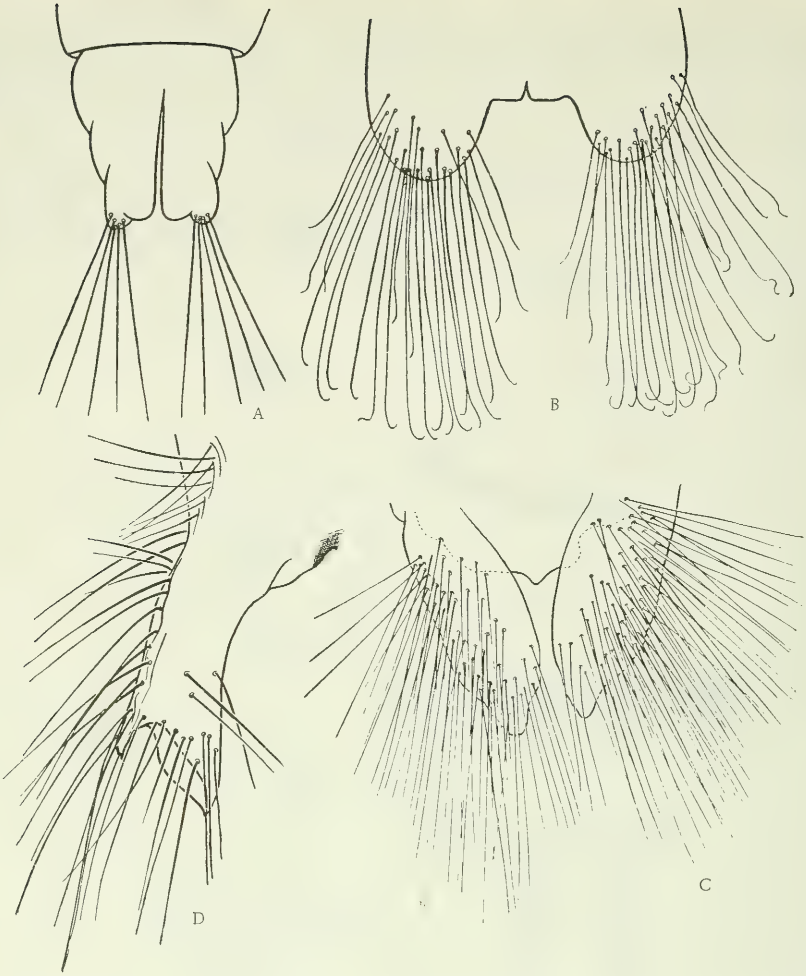


FIGURE 139. Anal appendages of Annulipalpia: Tinodes sp. (A), Holocentropus picicornis (B), Macronema radiatum (C), Hydropsyche nevae (D)

On the dorsal side of the abdomen, from the 3rd segment on (from the 2nd segment in the Psychomytidae, or from the 4th segment in the Rhyacophilidae to the 7th segment, rarely to the 6th segment in Molannidae and Beraeidae, or to the 8th segment in Polycentropodidae), the anterior margin of the segment bears small paired sclerites with posteriorly-directed crotches (Figure 137); similar sclerites with anteriorly-directed crotchets or spines are present at the posterior margin of the 5th abdominal segment of the pupa or sometimes posterior to the 3rd (Rhyacophila) or 4th (Agapetus) segments. The pre- and postsegmental dorsal sclerites (the number and arrangement of which are characteristic for the species) form the second part of the clinging apparatus of the pupa, which enable it to move

forward and backward inside the tube. In addition to the crotchet-covered sclerites, the abdominal segments bear rodlike sclerites (Figure 138, B) dorsally and ventrally along the segments; these thin sclerites are contiguous between the segments forming a kind of skeleton which reinforces the integument of the pupa; during histolysis and histogenesis,
92 when the internal organs of the insect have not yet developed, the integument may be deformed without this support.

In some Annulipalpia, the posterior end of the abdomen bears appendages (Figure 139) in form of broad or oblong setose lobes (Psychomyiidae, Ecnomidae, Polycentropodidae, Macronematinae) or wide rodlike processes covered with setae (Hydropsychidae).

In the suborder Integripalpia, anal appendages are present in the pupae of all families. In the Phryganeidae, Lepidostomatidae and some Dicosmoecinae, they form setose lobes; they are thin, straight or curved
93 rods of varying size and shape in most groups, covered with more or less long setae (Figure 140). The function of the anal appendages and their setae is the cleaning of the posterior opening of the pupal case.

The ventral side of the last abdominal segment of the male pupa bears a process in which the developing genitalia are enclosed; they are fully formed at the end of the pupal stage.

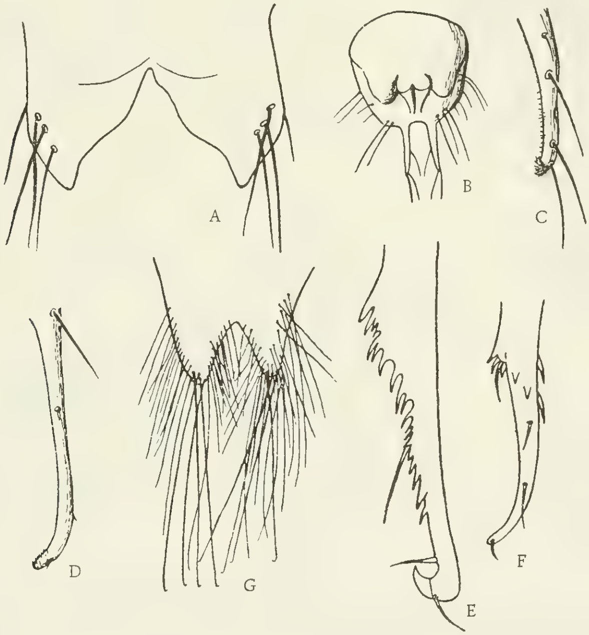


FIGURE 140. Anal appendages of Integripalpia: Agrypnia pagetana (A), Potamophylax nigricornis, posterior end of body of male, ventral (B), left anal rod, dorsal (C), P. stellatus, left anal rod, dorsal (D); Mystacides longicornis (E), M. nigra (F), Lasiocephala basalis, anal rod, dorsal (G) (A, E–G — after Thienemann, B–D — after Nielsen)

Pupation

**Preparation or alteration of the case.** At the end of the last stage, the larva begins to prepare itself for pupation. Its behavior changes; it ceases to feed, crawls to a concealed place for pupation and begins to build the pupal case. Larvae living in portable cases usually
94 attach their case to a fixed object and adapt it to the pupal stage; species of Annulipalpia with a free larva begin to build, before pupation, structures with an external layer consisting of material from their environment.

The larvae of Rhyacophila build a rooflike pupal case of small stones (Figure 141, A), attaching its base to the stone by dense strands of silk with numerous ventilation holes. The stones are solidly connected by similar ribbonlike strands; they are rarely fully contiguous; the larva does not build a continuous inner wall of the case but leaves spaces free of the silk (Figure 141, B); thus, although the pupal case of Rhyacophila is very strong, it is also open to circulation of the water.

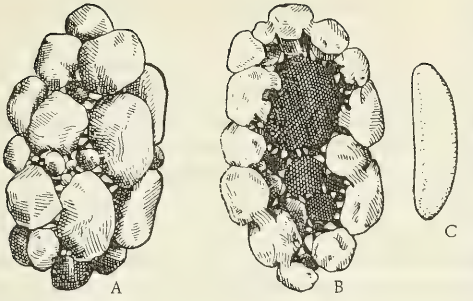
After completion of the case, the larva of Rhyacophila begins to weave the cocoon which is characteristic for all Annulipalpia; however, unlike the cocoon of the other families of the suborder, the cocoon of Rhyacophilidae and Glossosomatidae is very thick and strong.

The larva of Rhyacophila begins weaving the cocoon by drawing longitudinal threads from one end of the cave to the other, so that the larva is situated inside the threads; the larva then interweaves the longitudinal threads with transverse and oblique threads (Figure 142); it fills the small open spaces with silk, so that a thick continuous elastic wall is formed. The pressure inside the cocoon is greater than the pressure in the environment so that the cocoon becomes inflated and its walls become shining and smooth; when the wall is pricked with a needle, it collapses and the fluid flows out. The dorsal surface of the cocoon is convex and the ventral surface is slightly concave in the middle so that the cocoon has an oblong form like a bean (Figure 141, C). The cocoon is suspended in the case, its ends being attached to the wall of the case by longitudinal threads. The larva which is ready for pupation (prepupa) assumes the typical posture preparatory for the molt: the head is turned under and pressed to the thorax, the forelegs are directed forward and the mid- and hind legs are extended along the body.

The cocoon is built by the same method in the family Glossosomatidae. The cocoons of the preceding families are characteristic structures which are not found in other families of Annulipalpia.

The pupal case of Glossosomatidae consists of large sand grains (Figure 143); it differs from the case of the larva in the absence of a lower wall; in certain forms (Synagapetus) the wall consists of coarser material; the base of the case is attached to a stone by a broad band of silk and is provided with ventilation holes. The form of the pupal cases of this family resembles that of Rhyacophila, but they are much smaller (8–10 mm in Glossosomatinae, 4–6 mm in Agapetinae).

The larvae of some genera of Hydroptilidae (Agraylea, Oxyethira) do not alter the larval case; before pupation, they attach the flat side of the cases to the substrate by short strands of silk; these strands have disk-
96 shaped wide ends ("plates") (Figure 144); the anterior and posterior case openings are covered with a thin membrane. Before pupation, the larva of



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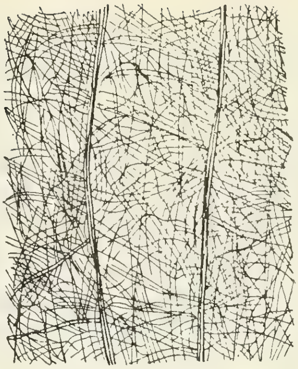

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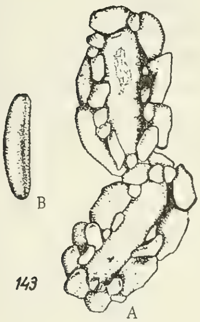

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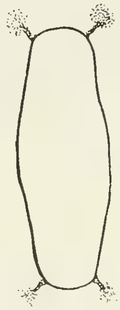

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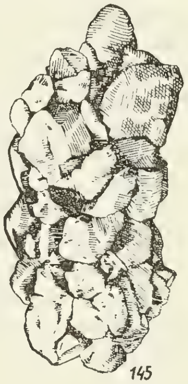

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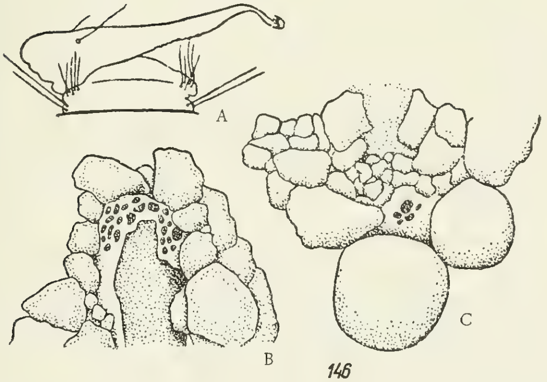

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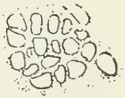

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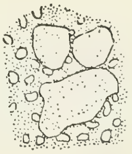

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FIGURES 141–148. Pupal cases of Annulipalpia and their parts:

141 – pupal case of Rhyacophila subovata, outer view (A); wall of the same case, inner view (B); cocoon (C); 142 – part of an incompletely woven wall of the cocoon of Rh. sibirica; 143 – prepupa of Mystrophora altaica in the pupal case (A); cocoon (B); 144 – pupal case of Agraylea multipunctata; 145 – pupal case of Stenopsyche bergeri, dorsal; 146 – pupa of Tinodes sp.: labrum and left mandible (A); anterior (B) and posterior (C) ends of case; 147 – Holocentropus picicornis; 148 – Hydropsyche sp. – openings in the membrane at the posterior end of the case (146–148 – after Thienemann).

Orthotrichia tetensii extends the walls of its case by weaving light processes at the sides; these processes are connected on the dorsal side and with the large adhesive disk at the ventral side.

The pupal cases of Philopotamidae (Wormaldia) resemble the cases of Rhyacophila, but they are smaller and their building material is not so densely connected; the whole structure is looser; its walls, which consist of small stones and sand grains, are smoother. The sand grains and stones form the upper layer of the inner wall of the case; the base of the case is attached to a stone. The cocoon of the pupa is transparent and delicate; its ends are attached to the wall of the case; there are several small openings at the places of attachment; the ends of the cocoon near the openings of the case are especially thin-walled. There are no other ventilation holes.

The cases of the pupae of Stenopsychidae, which live in brooks and streams, are solidly built of large sand grains or small stones (Figure 145).

The larvae of Psychomyiidae build a loose pupal case of silk which they cover with sand grains or small stones on the outside; there are numerous openings at the anterior end and at the base of the case; the openings at the posterior end are less numerous (Figure 146, B, C); the position of the openings is connected with the morphology of the pupa and its cleaning apparatus (Figure 146, A).

The domelike cases of the pupae of Polycentropodidae are situated on stones, plants and pieces of wood; they consist of loosely connected sand grains, small stones or fragments of plants. At the anterior and posterior ends of the case are relatively large openings covered with stones or plant fragments (Figure 147). The cocoon is loosely attached to the walls of the case; it consists of loosely woven, wide-meshed silk tissue. It is easier to tear the loosely built walls of the case and the thin cocoon of the pupae of Polycentropodidae than the strong walls and cocoons of Rhyacophilidae and Glossosomatidae; the mandibles of the pupa are less massive and are without serrations or teeth.

The larvae of Hydropsyche (Hydropsychidae) cover the pupal case with small stones, gravel or sand. The cases are attached to stones, pieces of wood, twigs or other objects (e.g., shells of mollusks). Numerous openings are situated at the posterior and anterior ends of the case (Figure 148).

Annulipalpia build characteristic, closed pupal cases with ventilation holes. Integripalpia pass the pupal stage in the larval case; they close the ends of the larval case with a membrane before pupation; this membrane is a coarse-mesh net or has one or several openings which are round or slit-like; the membrane of the posterior end of the larval case is replaced by a new pupal membrane with one or several openings.

97 The pupae of species living in stagnant water with large cases covered with large, projecting plant fragments, e.g., Limnophilus stigma, L. rhombicus, L. flavicornis, lie free on the bottom or are loosely attached to plants or detritus particles; the pupae of Grammotaulius signatipennis, which live in shallow water overgrown with plants, swim on the surface in their short massive cases. Most of the species of Integripalpia which live in running and stagnant water attach their cases to objects before pupation (Figure 149); they alter them to some extent and sometimes even camouflage them.

Species living in rapid currents attach their cases, which consist of stones or reeds, to stones before pupation; they shorten them and close their ends with stones, sand grains and membranes with openings. Some of these cases are attached to stones; they are flattened dorsoventrally, have rounded smooth ends and openings in the membrane near the ventral margin; they resemble the cases of Annulipalpia, but the principle of construction is quite different; they form a tube with a flattened ventral wall which separates the pupa from the substrate.

The pupal cases of Integripalpia are modified larval cases and resemble them on the whole. The cases of different genera, and sometimes also of different species, differ in the method of attaching the case to the substrate, the method of closing its ends, the form of the membrane closing the ends of the case, and the number and form of the openings in the membrane.

The larvae of Phryganeidae, which live in stagnant water, close their straight tubes before pupation with sievelike nets with broad meshes; they cover the outer side of the nets with numerous thin stalks and leaves which are more numerous at the anterior end than at the posterior end (Figure 150). The larvae of Grammotaulius atomarius shorten the pupal case; they cover its anterior part loosely with leaves of cane; the sievelike closing membrane of the pupal case of Grammotaulius is a thin net with large openings separated by narrow strands of silk (Figure 151, A, B).

Some species of Limnophilus close the pupal case with a sievelike membrane which is continuous or divided into parts by sand grains or pieces of detritus (Figure 152). The larvae of Potamophylax living in running water (e.g., Potamophylax stellatus and P. nigricornis) round the ends of the cases, closing them with sand grains and small stones between which remain areas of membrane with openings which are more numerous at the anterior than at the posterior end (Figure 153).

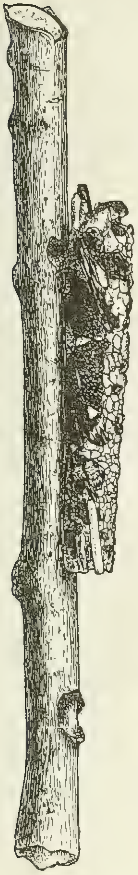
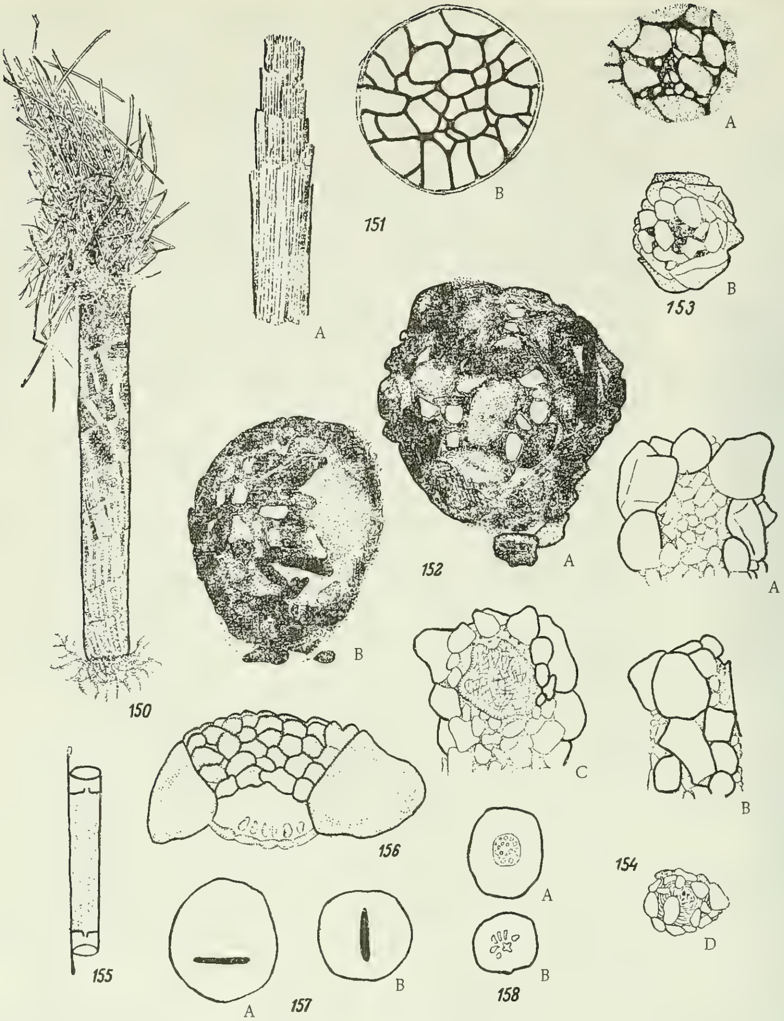


FIGURE 149. Pupal case of Mystacides longicornis attached to a twig 99

Species of Apatania extend the case anteriorly, adding a hood of small stones which are as large as those at the sides; the anterior opening of the case is thus displaced ventrally to the stone on which the larva pupates and is attached to it by silk threads; only a narrow band of membrane with a row of small openings remains at the anterior end; 3 or 4 small openings are present in the middle of the membrane at the posterior end (Figure 154).

The pupal cases of Molanna lie free on the bottom; the wings of the case are usually short, as the larva does not add to them during the last stage; the anterior opening is closed with a membrane covered with fine sand grains; there is one small opening at the periphery of the membrane, near the dorsal margin; the posterior part of the case bears a narrow vertical slit in the middle.



FIGURES 150–158. Pupal cases of Integripalpia:

150 — Phryganea striata; 151 — Grammotaulius signatipennis (A) and its sievelike membrane (B); 152 — ends of the case of Limnophilus extricatus: anterior end (A), posterior end (B); 153 — posterior end of case of Potamophylax nigricornis, inner view (A), outer view (B); 154 — ends of the case of Apatania muliebris: anterior end, dorsal (A), lateral (B), ventral (C), posterior end (D); 155 — diagram of the pupal case of Mystacides sp.; 156 — posterior end of the case of Silo pallipes; 157 — closing membrane of the case of Sericostoma personatum, anterior end (A), posterior end (B); 158 — closing membrane of the case of Micrasema minimum, anterior end (A), posterior end (B) (153, 154 — after Nielsen, 155–158 — after Thienemann).

The species of Leptoceridae, living in stagnant water, attach their tubular cases to a plant before pupation (Figure 149); they place the anterior and posterior membranes within the tube, some distance from the case margin; there is a small opening with outward projecting margins in the middle of the membrane (Figure 155). In species with a short, broadly conical pupal case, e. g., in Leptocerus senilis, the case has an anterior transverse slit and a round opening posteriorly; the cases of L. annulicornis and L. excisus have long anterior and posterior transverse slits.

The pupal cases of the family Goeridae are covered anteriorly with a small stone bordered with a narrow band of membrane with slitlike openings; the membrane has similar openings posteriorly in its ventral part (Figure 156); in pupae of the Sericostomatidae, the anterior membrane contains a transverse slit, and the posterior membrane a longitudinal slit (Figure 157); in the Brachycentridae, groups of small openings are concentrated in the middle of the anterior and posterior membranes (Figure 158).

After the case is closed, the prepupa and the pupa usually remain in the same position as during the larval stages; this position is changed in some cases, e. g., in Molanna angustata, the dorsal side of the pupa is directed toward the ventral side of the case, which is connected with the position of the openings of the membranes of the case and the cleaning apparatus of the pupa (Figure 162).

**Molting.** After the case has been attached and closed (after the weaving of the cocoon in Annulipalpia), the larva passes a prepupal diapause and then molts into the pupa; in some species, e. g., species of the tribe Baicalinini, the prepupal diapause is very long, lasting several months. The shed exuviae are usually destroyed, but the sclerites are preserved in the cocoon of Annulipalpia or in the tube of Integripalpia; This makes it possible to identify larvae and pupae of the same species. The larval sclerites are especially well preserved in the closed cocoon of Rhyacophilidae; the sclerites are visible through the semitransparent walls of the case as a dark mass in the posterior end of the cocoon. Preparations of fully developed genitalia of the imago, can be made from a pupa ready to hatch, so that the species can be identified.

### Life of the pupa inside the pupal case

During most of the pupal stage (which lasts 7 to 28 days or longer), the
pupa moves little; only at the end of the pupal stage, before hatching, does
100 the pupa swim or remain in the air for a short time, several minutes or less.

During the histolysis in the pupal stage, small groups of muscles are retained which enable the insect to make some movements; these movements ensure respiration inside the chambers and tubes. This is attained by undulating movements of the abdomen in the Integripalpia and some families of Annulipalpia (Polycentropodidae, Arctopsychidae, Hydropsychidae). The undulating movements in the tube create a current from the anterior to the posterior ends of the case; the abdomen and gills of the pupa are thus washed continuously by fresh water (Figure 159). The intensity and frequency of these movements vary with the temperature and oxygen contents; the movements become more frequent when the oxygen content falls and vice versa. In the Integripalpia, the "anchor" which holds the moving pupa to a point consists of the dorsal tubercles or ridges of the 1st abdominal segment of the pupa, which have been described earlier; the pupa clings to the walls of the case with crotchets and spines. The lateral line of the Integripalpia is covered with a row of dense and long setae which intensifies the current in the tube.

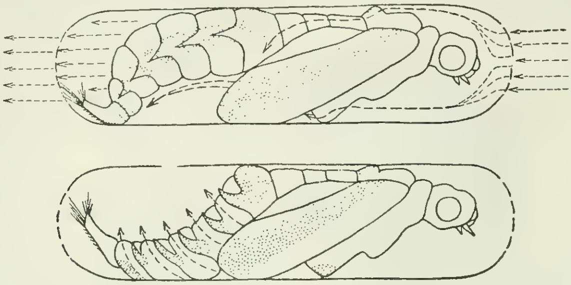
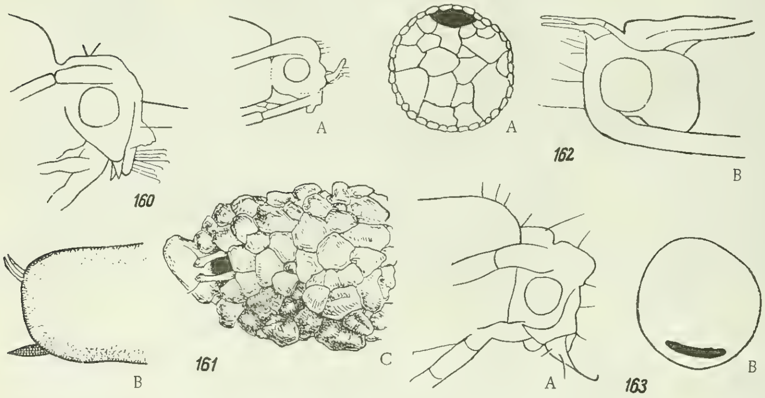


FIGURE 159. Pupa of Hydropsyche sp. in the cocoon, in the current created by its movements (after Sattler)

(101)



FIGURES 160—163. Cleaning apparatus of the pupa:

160 — head of pupa of Parachiona picicornis with setae of the labrum; 161 — mandibles and anal rods of the pupae of Leptoceridae: head with mandibles of Mystacides longicornis (A), opening of the posterior end of the case of Leptocerus senilis, cleaned by the anal rods (B); same of L. aterrimus (C); 162 — Molanna angustata: anterior cover of case with dorsal opening (A); position of the head of the pupa inside the case (B); 163 — Odontocerum albicorne: position of the head of the pupa (A) when the anterior opening of the case is ventral (B). (All drawings after Thienemann, except 161, C)

The current of water sucked into the pupal case is rarely free of matter which clogs the openings of the membrane and sieves; the pupa uses its cleaning apparatus to clean the membranes; this apparatus consists of setae

on the labrum, ends of the mandibles and anal rods or lobes; labrum and mandibles are used for cleaning the openings of the anterior membrane; the anal rods are used to clean the posterior openings. The crotchets of the presegmental plates support the pupa when it moves forward to clean the anterior membrane; movements backward are made possible by the support of the anteriorly directed crotchets of the postsegmental plates; because the anterior membrane clogs more rapidly than the posterior membrane, more work is necessary to clean it. The plates with the crotchets have to be disengaged for moves in any direction; when the pupa moves backward, its body contracts, the presegmental plates near the
101 anterior margin of the segment are covered by the posterior margin of the preceding segment and the pupa can move posteriorly. When the pupa moves forward, the postsegmental plates change their position; they retract and become inclined, descending slightly forward and inward; their setose surface then becomes disengaged from the walls of the case on which the presegmental spines are engaged and the pupa moves forward.

The clinging apparatus also functions when the pupa emerges from the case; it is therefore present in pupae of Annulipalpia.

The cleaning apparatus of the pupae varies markedly. Cleaning usually is performed by the setae at the anterior and posterior ends of the body (Figure 160). In the pupae of Leptoceridae (Figure 161), the anterior slit of the case is cleaned by biting with the mandibles; the anal rods move separately and together during the cleaning of the posterior opening. The pupae of Molanna, the ventral side of which is diverted to the dorsal wall, introduce the tips of the mandibles into the dorsal slit (Figure 162). The pupae of Odontocerum albicorne clean the slit at the anterior end of the case by biting with the long, curved and narrow end of the mandibles (Figure 163).

The pupae of some species (Goera pilosa, Silo pallipes, Potamophylax nigricornis, Odontocerum albicorne) are
102 parasitized by wasps of the genus Agriotypus (A. armatus, A. gracilis). Observations on the host, parasite and the latter's life cycle have been reported by Klapálek (1889), Clausen (1931) and Fischer (1932).

## Emergence of adult insect

**Emergence from the case.** When the development of the pupa is ended, and the imaginal organs are developed, the pupa leaves the case; it leaves the water, molts and the imago hatches; if this is inhibited, the insect dies. The pupa tears the membrane of the case with the denticles of the mandibles (Figure 164); when the insect molts, it discards the muscles of the mandibles together with the pupal exuviae; the denticles of the mandibles wear off markedly when the pupal case is torn.

The pupa uses its presegmental plates and anal legs to leave the case and begin to swim. The pupa is very mobile; some pupae swim with the dorsum downward, like Notonecta. Large species swim more slowly than small species; the pupae of the small species of the family Hydroptilidae move so rapidly that it is difficult to follow the movements of their legs.

**Emergence to land.** The pupae of species living among humid moss or plants near the water surface do not swim; they crawl from the water onto plants or stones, e. g., some species of Sericostomatidae and Lepidostomatidae (*Notidobia ciliaris, Crunoecia irrorata*); the pupae of these species do not have swimming legs.

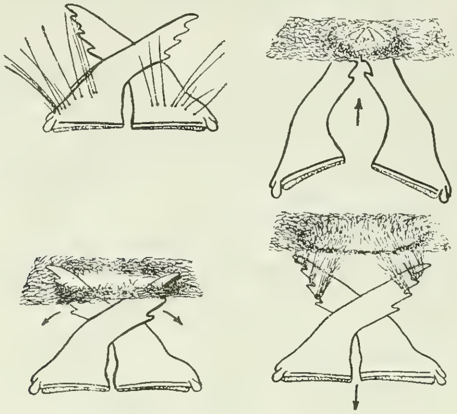


FIGURE 164. Movements of the mandibles of the pupa of *Hydropsyche* sp. when it tears the membrane (after Sattler)

The swimming pupae also crawl or climb on the land, remaining in the water only until they reach an object to which they can cling so as to leave the water. The pupae climb on stalks of plants or grasp stones or the sand of the shore. The pupae of most groups living mainly in running water use their claws to leave the water. The claws are well developed in the pupae of Rhyacophilidae, Philopotamidae, Psychomyiidae and Polycentropodidae; 103 among the Integripalpia, they are developed in Phryganeidae and some species of Lepidostomatidae (*Lasiocephala basalis, Crunoecia irrorata*). The pupae of some species of Baicalinini (Apataniinae) leave the water in large numbers in early spring through cracks in the ice (Gusev, 1956); mass emergence is also characteristic for many species of Hydropsychidae and Hydroptilidae.

**Hatching of the imago.** Some small species hatch by flying up directly from the water; however, the last molt usually takes place on the shore. The pupa crawls on the ground or an object projecting from the water and becomes dry. When the molt begins, a slit appears on the dorsum of the thorax, reaching the base of the head; the antennae become free, and then the insect extracts the fore- and midlegs; the insect then frees its wings and hind legs and discards the exuviae by movements of the abdomen; it spreads its wings, makes a few steps and then halts and breathes energetically; the wings soon attain their pattern and coloration, and the insect flies off.

Trichoptera hatch in masses (like mayflies) in large water bodies inhabited by larvae which develop at about the same time, e. g., in large rivers in valleys. Hydropsyche ornatula emerged in large numbers in the Volga before its reconstruction, and at present they emerge in those parts of the Volga which have retained their river character; this is true also at the Oka and other tributaries of the Volga which have retained their natural character. Large numbers of Arctopsyche ladogensis and Hydropsyche nevae hatch in early summer in the Neva and Svir' rivers. Great numbers of Macronematinae (Macronema radiatum, Aethaloptera rossica) fly along long stretches of the Ob, Yenisei, and Amur. Caddis flies emerge in enormous masses in Lake Baikal.

## ENVIRONMENT

### Ecological differentiation of caddis flies

The Trichoptera are an ancient order which were already differentiated in the Permian (Martynov, 1938); during their long existence, they passed a complicated evolution, connected with the formation of continents and changes in the hydrographic network of the land. While adapting to changing habitats, the larvae settled in a wide range of water bodies. They became adapted to the different biotopes of running water or stagnant water, and developed various morphological and physiological adaptations; they also
104 developed a high ecological differentiation. In addition to narrowly specialized species restricted to a few biotopes, large groups of ecologically flexible species have a wide ecological range and live in variable conditions.

Below, we describe the relation of Trichoptera to different factors of the aquatic environment. The habitats of Trichoptera in different water bodies and biotopes are described in the next chapter.

### Degree of mineralization of water and organic matter

Adaptation to different degrees of mineralization of water affects the physiology of the organism markedly; it requires changes in the osmotic pressure of the body fluid, modification of the osmoregulatory process and reconstruction of the organs concerned. Caddis flies live mainly in continental fresh water bodies of the calcium hydrocarbonate group with a prevalence of $HCO_3$ anions and the $Ca^{2+}$ cations and with a small content of chlorides. The range of water bodies inhabited by caddis flies is very wide and includes snow streams in mountains, sphagnum lakes, some mountain lakes with low mineralization, as well as the hard, highly mineralized water of some lakes (e. g., Sevan Lake with a mineralization of 662 mg/l), and water bodies with an underground feed. Caddis flies widely inhabit fresh (ahaline) and oligohaline water bodies; they also occur in mesohaline waters, and are found, for example, near the coast of the open western part of the Gulf of Finland, with a salinity of 5–6‰ (Siltala, 1906:9), where several forms of the ordinary lake fauna occur (they are widely distributed on the fresh-water littoral of the Gulf of Finland), and also

Agrypnetes crassicornis, which is one of the few species occurring only in water with a high mineralization (e. g., Lake Sevan) or in slightly brackish water. The common freshwater species are absent in the Aral Sea (salinity 9.5–10.5‰ ) and are replaced there by A. crassicornis and the only halobiont caddis fly of the USSR, Oecetis intima, which is known from the Caspian Sea in the region of Mertvyi Kultuk (Bening, 1934:194; 1937:172; 1940:95). McLachlan (1887:154–155) recorded the larvae of Philanisus plebejus from the coasts of New Zealand and Australia, living among rocks of marine shores in cases built of coral; this species was recently separated as the family Philanisidae (Mosley and Kimmins, 1953:131–132).

The larvae of Trichoptera are very oxyphilic; they are highly sensitive to the increase of organic matter in water, and they usually inhabit clean water bodies such as springs, mountain streams, large oligotrophic lakes (Lake Baikal, oxygen content 1.1 mg $O_2$/ l, mineral content = 92 mg/ l; Lake Teletskoe, oxygen content 3.5 mg $O_2$/ l, mineral content = 68 mg/ l) and large rivers in the plains. In eutrophic lakes, ponds, and calm streams overgrown with plant, caddis flies live in places with little natural pollution, and zones with algae with a favorable oxygen regime; they avoid the bottom in these water bodies, which is strongly polluted with organic matter and sapropelic slimy deposits; however, under conditions of natural pollution in regions with algae, or in sandy-slimy regions, the larvae of Anabolia, Molanna and some species of Limnophilus occur. Kolkvits and Marson consider several species of caddis flies as oligosaprobiotic. Caddis flies avoid polluted water bodies. During a study of the relation between pollution and various groups of aquatic animals in the vicinity of Kharkov, only a few specimens of Orthotrichia tetensii were found in places with a high pollution (Lepneva, 1929:609).

## 105 Oxygen

The high oxyphily of the caddis fly larvae is connected with their ancient occurrence in running water. In the tube-inhabiting Integripalpia, this is expressed by the undulating movements of the abdomen; under experimental conditions, the frequency of these movements increases when the oxygen content decreases; the free-living Annulipalpia do not make such undulating movements in nature, but they make them under experimental conditions in aquaria, and the frequency of the movements also increases in this group with the decrease of oxygen content; the minimum oxygen content at which the activity and movements cease ranges (according to observations on species with different ecological characters) from 0.0 to 4.0 mg/ l: for Potamophylax stellatus in stagnant water it is 0.7 mg/ l; for Anabolia nervosa in stagnant water 0.0 mg/ l and in running water 0.7 mg/ l; for Hydropsyche instabilis in stagnant water 3.3 mg/ l, in running water 0.9 mg/l; for Wormaldia subnigra in stagnant water 4.0 mg/ l, in running water 0.4 mg/ l. The species of Annulipalpia thus have a markedly higher tolerance to oxygen deficiency in running water, and their tolerance approaches that of Potamophylax stellatus (Integripalpia) in stagnant water.

The distribution of caddis fly larvae in the depth of water bodies is limited because of their high oxyphily. They are restricted to depths of a few centimeters; some species even occur outside the water, in puddles among detritus, especially among fallen leaves at the edge of springs, where rocks are washed by water, or among moss, e. g., the larvae of Stactobia catoniella, Ptilocolepus granulatus, Tinodes assimilis, Crunoecia irrorata, Berea maurus, B. pullata, Ernodes articularis, which belong to the fauna of humid biotopes called "fauna hygropetrica."*

In rivers with an almost uniform distribution of oxygen in the water, caddis flies (mainly Hydropsychidae) are common near the banks along the whole profile of the river; they have been found in the Volga to a depth of 10–11 m and in the Amur to a depth of 17–20 m. In lakes, larvae of Trichoptera occur mainly in the littoral, where a high oxygen content is created in summer by the dynamics of the water and photosynthesis. In oligotrophic lakes with a high oxygen content and in deeper water layers, caddis flies also occur in the sublittoral; a few specimens also in the upper profundal zone.

In the lakes in Karelia, species of Molanna (M. angustata, M. palpata, M. submarginalis), Mystacides azurea, Oecetis ochracea, Cyrnus flavidus occur in the sublittoral; there are also isolated specimens of Apatania wallengreni, Chaetopteryx sahlbergi and Phryganea striata; some of the above species also occur in the upper profundal zone to a depth of 10–20 m (Lepneva, 1928:98–99; Gerd, 1949:85, 178). In the littoral of Lake Teletskoe Mystacides dentata and Apatania stigmatella may be found to a depth of 20–30 m (Lepneva, 1949:169, 181, 189). The species of Apataninnae are richly represented in the littoral of Lake Baikal; they are common at a depth of
106 25–30 m; they have been recorded rarely from the profundal zone, to a depth of about 200 m (Bebutova, 1941:82–84; Levanidova, 1946).

### Temperature

The larvae of Trichoptera commonly inhabit continental waters; they are therefore adapted to very different thermic regimes. In high and middle latitudes of the USSR, all caddis flies in temperate and cold climates tolerate a low water temperature in winter (near 0°) and some species even become frozen in the ice. In rivers with bottom ice, there is often the whole hibernating fauna of caddis flies enclosed in the ice; in the Neva, for example, viable larvae of Hydropsyche nevae and Arctopsyche ladogensis are found in pieces of bottom ice. It is therefore interesting to discuss the relation of Trichoptera in temperate latitudes to the upper limit of the thermic range, i.e., to the maximum water temperature in summer. Caddis flies, which live in insolated shallow water, do not include stenothermal species (eustenothermal species) and resemble species living in the depths of lakes or relict species in caves; the latter species live at a constantly low temperature with small yearly fluctuations. We usually consider as cold-water stenothermal species in the broader sense the numerous groups of caddis flies living at low temperatures in summer (4–6°; 5–8°) or a relatively low temperature in summer (8–12°; 10–16°) in springs, brooks and streams fed by springs or snow, in cold water bodies in high mountains or at high latitudes, and in the open surf littoral of deep cold-water lakes in which the littoral is constantly cooled by the wind, which drives the surface water warmed during the day from the shore to the open lake.

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* For further details on the Trichoptera of the "fauna hydropetrica" see: Thienemann, 1905b:553–556; 1909–1911:66–68; 1923, 1924, 1925:46–51; Vaillant, 1954, 1956:152–243; Jacquemart, 1960; Danecker, 1961.

The stenothermal species which live in brooks and streams fed by springs or snow occupy large areas, from the spring or snow sources to the limit where the summer temperature of the water, together with the increase in depth and strength of the current, prevent the existence of these species, which are adapted to the cold upper reaches of the stream. The upper limit of the water temperature inhabited by a stenothermal species is determined by the daily maximum in the lower zone of distribution of a mountain species. The daily range of the water temperature is clearly marked in shallow water near the coast on clear days with intense insolation; the warming of the water mass mixed by the current is on such days increased by the heated stones projecting from the water near the shore and heating of the bottom of the stream.

Strictly stenothermal are the Middle Asian mountain genus Himalopsyche (H. gigantea, Himalopsyche sp. "larva hoplura") from Kirghiz, Dzungarian, Trans-Ili and Talass Ala-Tau and the Fergana Range at an altitude of 1,700–2,200 m; the larvae live in snow-fed and spring-fed streams with a summer water temperature of 5–9°. Under similar conditions and at a similar altitude we found in summer 1944 larvae of both species in rivers in the Gissar Range: Obi Khil'fa (4.6–8.5° – 17–21 July),
107 Mai Khur (8.0–10.1° – 23 July), Sara Dzhou (6–7° – 22–30 May), Mazor Darya (1.5–6.8° – 25–27 May); near the bank of a river at a depth of 20–40 cm, at about 2,300 m near the health resort Khodzha of the Obi-Garm District in August 1944 the daily temperature range in Mazor Darya was as follows: 15 August, 08.00 – 8°; 12.00 – 12.1°; 16.00 – 14°; 20.00 – 10.2°; 16 August, 08.00 – 8°. The maximum temperature in the habitats of H. gigantea in Mazor Darya was 14.2° (12 August 1954); larvae of H. gigantea were absent lower in the stream, in the estuary of the Mazor Darya with a water temperature of 18.5° at 17.00 on 9 August 1944.*

Among the stenothermal species restricted to the mountains of the Caucasus, larvae of Rhyacophila forcipulata and Rh. bacurianica (Lepneva, 1946:330–331; 1962:62) live in the high mountains of the Trialet Range (2,200–2,300 m) in sources with a summer temperature of 5° in July (1 July 1939) and 9° in August (20 August 1953); at 1,700–1,800 m, larvae of the species cited, together with larvae of other species of Rhyacophila, live in the rivulet Bakurianka (issuing from the same sources), forming large populations throughout the river at a markedly higher summer temperature which reached 12° in June (15 June 1939), 10° in July (1 July 1939), 15.5° (15 July 1953), 17.1° (18 July 1953, at 13.20); in shallow-water arms of the brook, the temperature was 20° on 19 July, 11.30; in August, the daily temperature of water in the brook fluctuates from 17° (3 August 1953 at 16.00) to 16° (24 August 1953), falling on some days to 14° (10 August 1953). The range of temperature of the cold-water mountain Caucasian species is thus 5–17.1° in summer.

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* According to my observations.

The thermal conditions of the water bodies of spring regions in lowland and plain landscapes inhabited by stenothermal species closely resemble those in mountain landscapes, as for instance in water bodies fed by underground sources on the Silurian plateau of the Leningrad Region.* In such springs and brooks, the larvae of species of Apatania (A. zonella, A. wallengreni) occur at a temperature of 5–13°; in aquaria they tolerate a temperature of 14–15°; the larvae of Potamophylax stellatus and Chaetopteryx sp. live in summer in springs at a temperature of 5.4–6.5°; in the brooks and streams issuing from these springs, they live at temperatures to 14°; larvae of Rhyacophila septentrionis were found in summer at temperatures of 5–16°; the larvae of Rh. nubila and Hydroptila maclachlani were found at a summer temperature of 11–16° (Lepneva, 1930:283).

In the Nakhodna brook (Kalinin Region) Rhyacophila nubila larvae were found in the short summer also at 18.8° on 5 July 1951.

In the Altai, the stenothermal species Ecclisomyia digitata (Praecosmoecus digitatus) lives in springs with a temperature of 8.5° and in the open littoral of the cold-water Lake Teletskoe; the temperature in this lake fluctuates from 3–6° in May and June; during the short summer (on windless days) it fluctuates from 10–12° in August; however, when the wind drives the warm surface water to the open lake, the temperature falls again (sometimes to 7–8°).

The widely used definition of a large group of species as cold-water stenothermal species is thus justified only because it stresses that this group is restricted to water bodies or to parts of water bodies with a low, or relatively low, summer water temperature, and also that these species
108 are absent in warm water bodies; a number of stenothermal species can tolerate the short period of high temperature during the summer maximum. The thermal range of the habitats of the stenothermal species is not uniform; this is not yet sufficiently understood.**

The inhabitants of stagnant water bodies in the plains or water bodies with a slow current are usually placed in the group of eurythermal forms (in the broad sense of the term). These water bodies are usually well warmed for long periods and have a relatively high and constant summer temperature with a maximum of 22–25° or more; eurythermal forms avoid cold water with a low average yearly temperature; some species, e. g., Limnophilus nigriceps, which has a wide ecological range (especially a wide thermal range), occur in cold-water lakes (e. g., in Lake Teletskoe) in biotopes in which the water temperature is unusually low in summer (8–12°). In the southern latitudes of the USSR, e. g., in Tadzhikistan, Trichoptera avoid small water bodies, including water bodies in which Anopheles breeds, which may reach a temperature of 30–32° in summer, although the oxygen regime of these open water bodies which are rich in green vegetation would not prevent the occurrence of caddis flies.

The larvae of Calamoceratidae live in the Far East among algae and detritus in calm backwaters of rivers at a constant high summer temperature which rises in shallow water to 20—27° (Levanidova, 1951:533). N. N. Konakov found in summer 1946 larvae of Limnophilus rhombicus and Molanna angustata in the fumarole zone of the South Kurile volcanoes, on Kunashir Island, near Tomari [on Sakhalin], in the nonfreezing Lake Honto, with fumaroles opening at the bottom of the lake; the larvae were found on the coarse-gravel littoral (M. angustata in large numbers); both species are widely distributed eurythermal forms (Konakov, 1956:169).

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* According to my observations in the region of Ropsha, Zaborot'ye, Gostilitsy, Taitsy and Pudost' in 1926–1928.

** Ross interprets the concept of cold-adapted forms broadly, including in this category whole families of the Palearctic and Holarctic region (e.g., all Phryganeidae and Limnophilidae). He considers life in cold and cool water as the ancient mode of life of caddis flies, which was characteristic for the whole order during the Mesozoic (Ross, 1956:19–20, diagram 2).

Eurythermal and stenothermal forms are not uniform ecologically; the groups of species are restricted in temperate latitudes to different thermal ranges in summer; the upper and lower limits of the thermal range in summer are not as important as the duration of the summer maximum, i. e., the average summer temperature. The life conditions of eurythermal forms in temperate and high latitudes in winter (water temperature near 0°) are the same as those of the stenothermal forms.

The eurythermal forms include species restricted to water bodies with wide yearly fluctuations of water temperature. Such forms are some genera of Polycentropodidae and a number of genera of Hydroptilidae (Annulipalpia) in the USSR; in the Integripalpia, most species of the family Phryganeidae; the tribe Limnophilini and some other groups which live in stagnant and slowly running water belong to this group.

The inhabitants of large rivers and some inhabitants of the surf zone of lakes, e. g., some species of Hydroptila, Hydropsyche, Cheumatopsyche, Neureclipsis and Leptocerus are a transitional group between eurythermal and cold-water species.

## 109 Light

Light, an important factor in the life of caddis fly larvae, is especially marked in the first stages of life when the larvae of many phytophilous species show a positive phototaxis. Strong light disturbs the larvae in the later stages, and they move to zones with less illumination, which is characteristic for most adult caddis flies.

The tendency to avoid strong illumination induces the larvae of many rheophilic species in cold springs and brooks to enter more or less deeply into caves as stygoxens. There are no stygobionts in the order Trichoptera; the status of Wormaldia subterranea described as a stygobiont is doubtful; the Rumanian specialist of Trichoptera Botoşăneanu considers this species as identical with W. triangulifera, which is a crenobiont widely distributed in springs of Yugoslavia, Rumania, Bulgaria and Italy (Botoşăneanu, 1959:37).

Several species of Stenophylax, Mesophylax and Micropterna were considered as stygophiles which are common in caves in central, western and southern Europe; the group of stygoxens is larger in these water bodies, including a number of common, widely distributed brook species; the following stygophiles of the fauna of Western Europe occur in the USSR: Stenophylax permistus, Micropterna nycterobia, M. testacea and M. sequax; the following stygoxens of Western Europe occur in the fauna of the USSR: Rhyacophila septentrionis, *Glossosoma boltoni*, *Plectrocnemia conspersa*, *Hydropsyche pellucidula*.*

The Trichoptera of caves in the USSR have been little studied; *Stenophylax permistus* from an adult insect was recorded as being found in caves in the Crimea (Pliginskii, 1927:175). The larvae of the stygoxen *Plectrocnemia* sp. have been found in caves in Transcaucasia (Lepneva, 1940:83, Figure 2).**

## Current and soil

As shown by the Russian name of Trichoptera ["rucheiniki" = inhabitants of streams], the larvae of Trichoptera are adapted to life in running water; different types and ecological groups of caddis flies occur in all types of running water, from slowly trickling sources to turbulent mountain streams, from calm brooks overgrown with vegetation to large rivers in the plains. It could be stated that in a large river which is hypsometrically and hydrographically diversified, the larvae of caddis flies occur throughout the whole network of the river system, in the sources, brooks or snow streams of the upper reaches and also in calm and small tributaries and in the large main stream in the plains; they also occur in the floodland of the river. The further from the origin of the current and nearer the regions of erosion and of water accumulation, the more the character of the stream changes, and with it, the ecological composition of the fauna of caddis flies, which is adapted to life in such different conditions of running water. The speed of the current in the habitats of different species of rheophilous larvae varies greatly; the current may be so slow as to be hardly noticeable, as in a
110 trickling source or an arm of a steppe brook where it may run less than 1 cm/sec, or it may be a turbulent stream with a force of 2–3 m/sec.

The relation of a rheophilous bottom organism to the current is closely connected with its relation to the soil of its biotope.

To retain a steady position in the current of a stream, the caddis fly larva must attach itself to an immobile substrate. This is achieved by the development of adaptations which enable these insects which live as lithorheophiles on the bottom to fulfil their principal biological functions: feeding, respiration, growth, molting, construction of cases and pupation.

The most stable ground (often the only ground in mountain streams) on which the larvae can settle are stones; the specificity of the life of caddis fly larvae in rapid streams is most marked in the fauna of stones. The adaptations to life on stones in running water are mainly intended to resist the force of the stream and are a complex of morphological and physiological characters which enable the larvae to exploit the current for other purposes, e. g., to collect food. The respiration of oxyphilous larvae is best satisfied in the current and on stony ground.

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* Details on the aquatic fauna of caves in Europe are given in the following publications: Ulmer, 1920; Radovanovic, 1932; Moretti, 1936; Murgoci, Marcoci, 1955; Botoşăneanu, 1959.

** These were possibly larvae of *Plectrocnemia latissima* Mart. (which is widely distributed in illuminated water bodies in the Caucasus) which changed their coloration and other characters in the caves.

The larva keeps itself in one place by a number of morphological adaptations and by the characteristics of its mode of life. Larvae of some higher species of Rhyacophila have flattened bodies; the insects adhere to the substrate with their ventral surfaces and crawl, clinging to irregularities of stones or to plants with the claws of their laterally directed legs and anal legs; the basal crotchet of the anal leg, together with the curved claw, forms a forceps with which the insects grasp an object (Figure 14). The basal crotchets and the claws of the anal legs of Philocrena trialetica from the upper reaches of the Bakurianka brook of the Trialeti Range (Figure 334) are very large; they form a long loop with which the larva holds itself on stalks of the moss Fontinalis, suspended in the current (Lepneva, 1956:909). The larvae of Rhyacophila have gills only in the pleural region of the abdomen and thorax; there are no gills on the dorsal and ventral surface; the long or tufted gills are directed laterally, forming a fringe on the sides of the thorax and abdomen.

The algae feeding larvae of Glossosomatidae, like the larvae of Rhyacophilidae, live on stones of rapid streams; they are differently adapted to life on stones than the larvae of Rhyacophilidae; like the larvae of Rhyacophila (Figure 165), which adhere to stones with their ventral surfaces, the larvae of Glossosomatidae adhere to stones with the flat underside of their cases and with their convex, streamlined upper surface. The larvae of Philopotamidae, Psychomyiidae and Polycentropodidae have flexible bodies without gills; like the larvae of Hydropsychidae, they live among stones in streams; the structures of Psychomyiidae are long, narrow galleries among pebbles on stones; in the Philopotamidae, these structures are short tubes which are slightly wider at the base; in the Polycentropodidae and Hydropsychidae, the structures are capturing nets of 111 various shape, with a shelter in the form of a characteristic chamber or funnel.

The speed of the current on the various parts of a stone is not uniform; it is usually maximal on the upper surface, weaker on the sides and weak or absent on the underside of stones even in turbulent rivers. The illumination of the different parts of stones also varies, and is reflected in the development of the algal overgrowth and therewith the food supply of species feeding on algae.*

The character of a stream changes when it passes from a mountain to the plain, and its soil also changes.

Finding a hard substrate for lithophiles is easier in rivers in plains and in brooks. In addition to settling on stones, caddis fly larvae occur on bottoms with pebbles, or sand-stone or clay; the larvae also occur on wood-like branches and wood fragments such as piers, bridges, etc. In addition, many larvae of the families Hydroptilidae, Psychomyiidae, Arctopsychidae and Hydropsychidae live on plants.

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* Observations of a part of the Dean River (England), with a rich rheophilic fauna of Trichoptera, showed that detritophages (Potamophylax stellatus, P. latipennis) predominate under stones in parts with a current slower than 0.2 m/sec., where vegetable and animal detritus is deposited; species feeding on algae (Glossosoma boltoni, Ecclisopteryx guttulata) occurred in large numbers on the sides and on the upper surface of stones, in parts with a current of 0.2–0.4 m/sec., among green algae and diatoms; they avoided the lower surface of stones, where the growth of algae is inhibited. The larvae of predators (Rhyacophila dorsalis, Hydropsyche fulvipes) also predominated on the underside of stones, where the zoobenthos concentrates, selecting biotopes more accessible to a current of over 0.4 m/sec. Species feeding on algae predominated, constituting 60.5% of the fauna of caddis flies on stones, while species feeding on detritus constituted 7%, and predators 6.1–7.3% (Scott, 1958).

Many species of Hydropsychidae which live mainly in mountain streams show the greatest development in large rivers in the plains. They are found almost throughout the profile of the river.

They use the dense tufts at the anterior margin of the labrum to clean their capturing nets which are clogged by detritus; this enables the species in large rivers in the plains to tolerate the water turbidity during floods in spring, summer and autumn; respiration is ensured by the tracheal gills on the sides and ventral surfaces of the larva.

The structures of the larvae of Psychomyiidae (Tinodes, Psychomyia), are found on the surface of the solid water bottom or on wood in rivers and brooks in the plains, as are also those of the larvae of Leptocerus and the nets of the larvae of Neureclipsis bimaculata. The larvae of Neureclipsis, with their delicate structures, find optimal conditions in small rivers in the plains with a moderate current, where they often occur in large numbers in plant thickets; they place their nets on the stalks and leaves of Potamogeton perfoliatus or other plants in the current.

When the current is slower or disappears in calm parts of running water bodies or in stagnant water, the bottom and its soil change; hard soil is
112 replaced by loose debris and deposits; in stagnant water, hard bottoms are areas of stony or clay bottom on the open littoral of lakes, wood fragments and macrophytes; loose bottoms are detritus deposits, sandy soils and slime deposits.

Conditions in the open, stony littoral washed by breakers resemble conditions on the stony bottom of a running water body; this enables some lithorheophiles which entered from running water to settle in these regions, where they live on stones together with other species of the lascustrine fauna.

In lakes Onega and Ladoga, these species are represented by Rhyacophila nubila, Polycentropus flavomaculatus, Hydropsyche angustipennis, species of Apatania, Potamophylax stellatus; species of Chaetopteryx and Leptocerus, etc., in Lake Teletskoe are represented by Apatania stigmatella, Dicosmoecus palatus, Anisogamodes flavipunctatus, Annitella obscurata, Lepidostoma hirtum.

Detritus-covered bottom is the only type of loose soil in stagnant water bodies which is widely inhabited by caddis flies; the life of lithophiles on detritus may be considered as life on small fractions of woody soil; as lithophiles living on stones may be found on large boulders, rocks, rock fragments, screes or pebbles, larvae living on wood may be found on large pieces of wood (tree trunks or large branches) or on coarse and fine wood detritus; the latter rarely consists of only wood and is usually mixed with leaves, conifer needles or partly decomposed parts of aquatic plants, especially reeds, sedge, Triodia, horsetail or riparian plants.

Life on a detritus bottom is closely connected with life among macrophytes; it results in the construction of cases covered with large particles of detritus (sometimes also with green plant fragments or sand grains and mollusk shells), as for example, in the following species: Limnophilus (L. flavicornis, L. politus, L. rhombicus, L. marmoratus, L. stigma, etc.).

A large group of phytophages and detritophages is closely associated with green plants, in stagnant or slowly running water bodies. Some of these phytophages have a protective coloration, and sometimes a protective form, as they build their cases from the vegetation on which they live and feed, e.g., the larvae of Triaenodes bicolor, which have cases covered with small spirally arranged green plant fragments and resemble green stalk; the flat case of Nemotaulius resembles a leaf of Potamogeton natans; the cases of Limnophilus decipiens and L. nigriceps are covered with small plant fragments or pieces of leaves of Elodea.

As the larvae of Trichoptera are ancient lithophiles, they rarely change to life on loose soil. Sand bottoms are rarely inhabited by caddis flies; the group of psammophiles in the families Molannidae and Leptoceridae is small; the species of Molanna and Molannodes are typical inhabitants of sand
113 and sand-detritus bottom; they usually occur in parts protected against strong waves and wind on solid and moderately mobile sandy soil. Species living on detritus and sand tolerate some silting; however, they avoid loose silt deposits; there are no pelophiles in the order Trichoptera.

The species of Annulipalpia are restricted to running water bodies in both hemispheres; they inhabit streams of varying size, the hydrographic regime and current of which vary within large limits. Annulipalpia definitely avoid stagnant water; the few recent species of Annulipalpia which have moved into stagnant water bodies (a few species of Polycentropodidae and a large part of the Hydroptilidae) have not lost their connection with running water. Life in running water may thus be considered as the ancient mode of life of Annulipalpia, while the change of some species to life in stagnant water should be considered as recent and secondary.

A similar proportion of rheophilic and limnophilic forms is present also in the Integripalpia; despite a widely held opinion, the inhabitants of running water, Integripalpia, should be considered as an ancient group which retained its ancient mode of life together with the Annulipalpia; the inhabitants of stagnant water of this suborder should be considered as recent immigrants there. The only difference is that this phenomenon is more distinct and widespread in the recent and progressive Integripalpia. This is very clearly marked in the recent and progressive family Limnophilidae, which is the largest family of Integripalpia (686 species). The largest subfamily of Limnophilidae is the widely distributed Holarctic subfamily Limnophilinae (403 species). That subfamily is mainly adapted to life in stagnant water, from deep, large lakes to small water bodies, including small temporary water bodies in spring (puddles). The other 5 subfamilies of Limnophilidae (Dicosmoecinae, Neophylacinae, Apataniinae, Drusinae, Pseudostenophylacinae) are typical inhabitants of running water. In the USSR, the families Odontoceridae, Beraeidae, Goeridae, Lepidostomatidae, Brachycentridae, Sericostomatidae are adapted to life in running water; the large family Leptoceridae contains both rheophilic and limnophilic species. The species of Molannidae predominate in lakes but are also found on the sand and sand-silt bottom in the riparian region of rivers. The two species of Calamoceratidae in the USSR live in calm backwaters of rivulets. There is only one family of Integripalpia, the family Phryganeidae, which lives almost exclusively in stagnant water,* but does not lose its connection

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* Wiggins (1962) established the new subfamily Yphrinae Wig. (Phryganeidae) for the species Yphria californica Banks, the larvae of which live in running water. Wiggins considers the genus Yphria as the most primitive genus of Phryganeidae; this suggests indirectly that the ancestors of Phryganeidae were rheophilic.

with running water; the species of Phryganea and Agrypnia inhabit not only lacustrine plant thickets but also riverine thickets in the plains. These species are often more abundant in the estuaries of these rivers than in lacustrine plant thickets, because of the more favorable oxygen regime;
114 genera living only in small sphagnum marshes (Holostomis, Oligostomis, Neuronia, Hagenella) develop well also in drainage canals with a slow current and dark water.

## WATER BODIES AND BIOTOPES INHABITED BY CADDIS FLIES

Of the large diversity of water bodies inhabited by Trichoptera, we mention only the few types in which the Trichoptera are represented regionally.

Water bodies of similar types (springs, brooks, rivulets and rivers with a similar hydrological regime, lakes of the same type with a similar bottom) are inhabited in different regions by different groups of species; these different groups which are restricted to water bodies and biotopes of similar type have the same ecological characteristics and are isoecological.

The present chapter discusses such isoecological groups which inhabit running and stagnant water bodies in different regions in the USSR.*

### Springs

The division of springs into limnocren, rheocren and heleocren springs does not always correspond to the emergence of underground water. In large regions of springs in which only a fauna characteristic for this region could develop, there is usually an intricate network of various types of water bodies (usually micro-water bodies) with an underground supply which is often connected. The stream of underground water (a trickling source or small brook), depends on the relief of the locality, and is either a small brook (rheocren, i.e., running spring) or an accumulation of water in depressions, forming a more or less closed and slowly flowing water body or micro-water body (limnocren, i.e., stagnant spring); when the relief is flat or slopes slightly, the ground water is retained in the soil or flows over stones, forming small flows overgrown with moss and other plants (heleocren, i.e., marshy spring).**

A constant low water temperature (4—6°) is maintained near the emergence of underground water throughout the year, preventing the freezing of the source in winter; the further away from the point of emergence, the more marked are the daily and seasonal fluctuations of the water
115 temperature; in localities with shallow floods supplied by springs, the water temperature sometimes rises to 16—18° and more in summer. Areas

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* However, there are very few stenotopic species, i.e., species restricted to one biotope; they are much less numerous than species with a broader ecological range. There are no "eurybionts" among Trichoptera.

** It is not justified, as proposed by V.I. Zhadin (1950b:708), to place a narrow terminological meaning to the popular names of sources such as "rodnik" and "klyuch," which are used widely and inaccurately in the geographical and hydrobiological literature.

covered with shrubs in forests, floodlands and near springs accumulate leaves and needles of trees, roots and twigs, and form typical biotopes fed by spring water. These biotopes are well ventilated and consist of layers of leaves, twigs and coarse detritus; they are inhabited by a characteristic fauna which is isoecological with the inhabitants of the fauna hygropterica.

In the northwest of the European USSR, springs of various types are numerous on the Silurian plateau; underground water emerges on their bottoms, often forming large limnocrens, numerous rheocrens, which give origin to brooks and marshy spring ponds. In rheocrens Rhyacophila septentrionis usually occurs at a temperature of 5—10°; however, this species is also found further downstream, in brooks with a summer temperature of 11—16°. It occurs there together with Rhyacophila nubila, which does not occur at a lower temperature (Lepneva, 1930; Nielsen, 1942:263). Larvae of Rhyacophila obliterata were found in springs in some localities (Latvia, Yaroslav Region). Larvae of Wormaldia subnigra, Plectrocnemia conspersa, Apatania zonella, Potamophylax stellatus, in some places Parachiona picicornis and Chaetopteryx villosa occur on the stony bottom of rheocrens. The fauna of limnocrens is poorer, e. g., the species Apatania zonella, A. wallengreni, Silo pallipes, Chaetopteryx sp., Potamophylax stellatus.* In the humid vegetation of floods and in the littoral stripe of springs the small larvae of Berea pullata, larvae of Crunoecia irrorata (with their tetrahedral detritus-covered cases) and larvae of Potamophylax nigricornis (the cases of which consist of sand or partly of detritus) are found.

In the rheocrens of the Caucasus, especially in Transcaucasia (spring zone of the Tskhra-Tskharo massif and the upper reaches of the Bakurianka) live a rich fauna of Rhyacophila, especially larvae of Rh. bacurianica and Rh. forcipulata (the gills of which have four short, thick, segmented filaments (Figure 228)), larvae of Rh. subovata, etc. Where the river bed descends steeply, larvae of Philocrena trialetica may be found under stones ranging among the moss; these larvae are a typical local endemic element of the spring fauna of the Caucasus. The species Agapetus sp., Plectrocnemia latissima, Apatania subtilis, Ernodes saltans, Dinarthrum tchaldyrense also belong to the spring forms of the Caucasus (Zhadin, 1940:685; Lepneva, 1946:325—331; 1956:901—909; 1957:13; 1961:652—658; Martynov, 1926a:59).

The larvae of Rhyacophila obscura, Glossosoma dentatum, Agapetus sp., Dolophilodes sp., Hydropsyche sp., Apatania copiosa, Pseudostenophylax secretus, Limnophilus asiaticus, Dinarthrum pugnax live in springs on the Hissar Range and other localities in Middle Asia; in higher localities one occasionally finds Himalopsyche gigantea (= Rhyacophila gigantea) (Lepneva, 1945:70; 1951:155; Martynov, 1927b:477, 485).

Sometimes large numbers of larvae of Ecclisomyia digitata (= Praecosmoecus digitatus) may be found on stone slabs in mountain springs in the Altai near Lake Teletskoe (Korbu Valley) in shallow ponds with a water temperature of 6—7° (Lepneva, 1949:61; Schmid, 1955:59).

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* The name Potamophylax Wall. (Schmid, 1955:175) does not correspond with the ecology of the species P. stellatus, which, like other species of the genus, is restricted to small running water bodies; this species thus belongs to an ecological group which differs from the fauna of rivers in the plains (potamophiles, potamobionts).

116 In some springs in the Amur basin, e. g., in the Mitriev spring (a limnocren with cold springs at the bottom and with a temperature of 4.8°) were found numerous larvae of Apatania sp.; there were 180 specimens per $m^2$, i. e., a biomass of 3.8 g/$m^2$ (Klyuchareva, 1952:366).

## Running water

**Mountain streams and brooks.** Sadovskii showed (1946:133–161; 1948:21–49) that for the small tributaries of the upper and middle Kura small mountain rivers and brooks have a rich bottom fauna, especially of insects, including caddis flies. The rich rheophilic fauna in these water bodies (defined as "polytrophic ventilated waters") (Sadovskii, 1946:133) is caused by a combination of favorable conditions: transparent water saturated with oxygen (it becomes turbid for only a short time during the torrential floods in summer), a solid, stony bottom of boulders, slabs or pebbles with numerous shelters for animals, and abundant food for phytophages and detritophages (algae and plant detritus). The caddis fly fauna of mountain streams resembles that of mountain brooks but is not so rich.

Many streams and brooks of the north and northwest European USSR (Karelia, in the Clint Region), and in the northern and central Urals, resemble mountain streams. The following species of Annulipalpia are common in them: Rhyacophila nubila, Hydroptila sp., Wormaldia subnigra, Polycentropus flavomaculatus, Plectrocnemia conspersa, Hydropsyche angustipennis and H. pellucidula; the following Integripalpia occur in them: Apatania zonella, A. wallengreni, Potamophylax stellatus, Halesus tesselatus, H. interpunctatus, Chaetopteryx villosa, Ch. sahlbergi, Silo pallipes, Notidobia ciliaris and Lepidostoma hirtum (Lepneva, 1928:102–103; 1953:187–191). Rheophiles which avoid rapid streams such as Anabolia soror, Anabolia furcata, Chaetopteryx sp., Goera pilosa occur in brooks and parts of streams with a slow current.

Rhyacophilidae are abundant in brooks and streams of the Caucasus. These are the same species which occur in rheocrens, i. e., the larvae of Rhyacophila forcipulata, Rh. bacurianica and often large numbers of Rh. vicaria and Rh. subovata; in Armenia and Transcaucasia occur Rh. subnubila, Rh. aliena and Rh. cupressorum in some localities and rarely, in warmer brooks, Rh. abchasica and Rh. clavalis. Glossosoma unguiculatum and G. capitatum occur on the lower surface of stones almost completely with their pupal cases in some localities; Agapetus caucasicus and A. truncatus are also common. Philopotamidae are represented by Philopotamus tenius and Dolophilodes ornata, rarely by Wormaldia subnigra. Psychomyiidae are represented in warmer brooks species of Tinodes (T. adjarica, T. turbulenta, T. sancta); Plectrocnemia latissima (Polycentropodidae) is common; in brooks and streams occur many specimens of Hydropsyche instabilis, H. cornuta, H. acuta. The family Beraeidae (Integripalpia) is represented by Ernodes saltans, E. palpata; the family Limnophilidae is widely represented by Apatania

subtilis, species of Potamophylax and Micropterna, rarely by Drusus caucasicus; the family Goeridae is represented by Silo proximum and S. tuberculatum; the Lepidostomatidae are represented by Dinarthrum longiplicatum, D. mesoplicatum, Crunoeciella batumica, Notidobia ciliaris (Sericostomatidae) and Micrasema bifoliatum (Brachycentridae). These species occur in large numbers; for example, 268–304 specimens per $m^2$ were found in
117 the Bakurianka stream (Transcaucasia), with a biomass of 2.6–4.8 g/$m^2$; 390 specimens per $m^2$ were found in the upper part of the Alazan (Murvanidze, 1948:71–72; Sadovskii, 1948:43).

In the mountains of Middle Asia, high mountain and mountain brooks, streams and small rivers form a complicated network of running water bodies of varying size supplied by sources, snow and ice. The Mazor Darya River of Tadzhikistan (Khodzha Obi Garm Region) is an example of large, snow-fed streams of the upper zone; it has a turbulent current and a water temperature of 8.0–10.5° in July and August; larvae of Himalopsyche gigantea and Himalopsyche sp. ("larva hoplura") are characteristic of this river and the upper reaches of other rivers and streams fed by snow; these species belong to a genus which is widely distributed in the mountains of central and southern Asia, especially in the Himalayas;* species of Himalopsyche occur in the USSR to an altitude of 3,200–3,500 m (Lepneva, 1945:70, 72; 1956:200; 1960:105–108).

Small rivulets fed from sources and warmed in summer to 14–18° (e. g., the Kondarinka and Koland'ye rivulets in the Gissar Range, and rivulets near Tashkent) have a more diverse fauna; commonly found in them are Annulipalpia: Rhyacophila obscura, Glossosoma dentatum, species of Agapetus (A. kirgisorum, A. bidens, A. tridens), Hydroptila sp., Stactobia olgae, Dolophilodes ornata, Tinodes turanica, Hydropsyche stimulans, Hydropsyche sp.; Integripalpia: Apatania copiosa, A. zonella, Pseudostenophylax secretus, Astratus alaicus, Dinarthrum pugnax (Lepneva, 1951:153–157; Martynov, 1927a; 1927b; Sibirtseva, 1958:169–179).

The brooks and streams of the Altai contain a characteristic fauna of caddis flies which is abundant in some localities. The following Annulipalpia were found in mountain brooks in the vicinity of Lake Teletskoe and the Chulyshman basin: Rhyacophila sibirica, Rh. impar, Rh. retracta, Mystrophora altaica, Dolophilodes sp.; Integripalpia: Ecclisomyia digitata, Dicosmoecus palatus, Apatania sp., Neophylax ussuriensis (= Halesinus ussuriensis, Schmid, 1955:96), Oligoplectrodes potanini, Lepidostoma hirtum.

Among the Annulipalpia, Glossosomatidae predominate; Glossosomatinae and Agapetinae were not found; unlike fauna in the Caucasus, the genus Rhyacophila (Rhyacophilidae) is widely distributed in this region by only one species, Rh. sibirica, which is common; the other two species occur only sporadically, the most common species Mystrophora altaica; the larvae and pupae of this species occur sometimes in large numbers on stones (Figure 165). The larvae of Apatania are rare (Lepneva, 1949: 189–191; 1950:119–124).

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* Zhadin (1950b:713) places H. gigantea among the crenobionts of the high-mountain zone, but this species inhabits (often in large numbers) a wide network of large mountain streams such as the Mazor Darya, Obi Khil'f, Mai Khura, Sara-Dzhou, the upper reaches of the Varzob (Lepneva, 1945:70; 1960: 105–107).

(118)

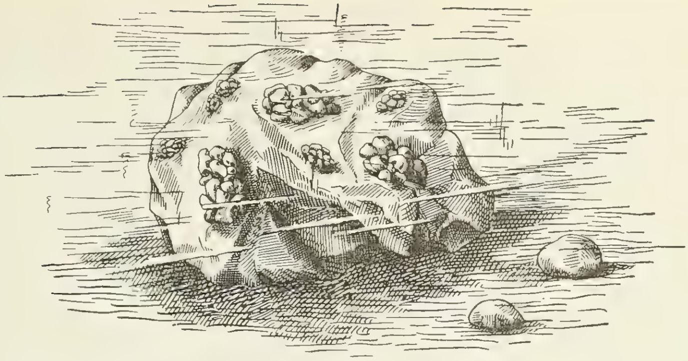

FIGURE 165. Pupae of Rhyacophila sp. and Mystrophora sp. on the lower surface of a stone (Rhyacophila pupae are larger and those of Mystrophora smaller)

A similar distribution is shown by Trichoptera of streams and brooks in the Western and Eastern Sayan Mountains and mountains in the middle reaches of the Yenisei. Rhyacophila sibirica, Mystrophora altaica, Neophylax ussuriensis and Oligoplectrodes potanini are most common; the larvae of Apataniinae (Figure 166) occur more frequently (Lepneva, 1948b:92–95; 1949:256–257).

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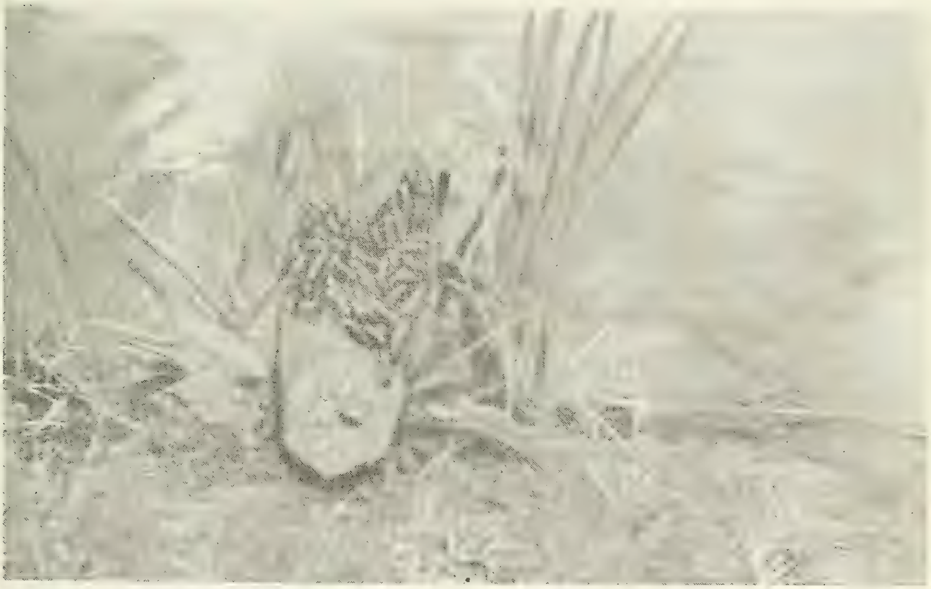

FIGURE 166. Pupae of Limnophilidae on a stone in the Malyi Arzybei rivulet in the Mana River basin (photograph by Dul'keit)

The fauna of Trichoptera of mountain streams and brooks of the Far East
from the mountains of Sikhote Alin and other localities in the Maritime
Territory is rich and diverse.* The following species were found at the
118 banks of streams and brooks with stony bottoms, rapid current, transparent
water and with a summer water temperature of 8.3–13.9° (Rezvoi, 1930:
467–476): Annulipalpia: Rhyacophila impar, Rh. narvae, Rh. lata,
Rh. retracta, Mystrophora ussurica, Dolophilodes orientalis, D. aurascens, Arctopsyche palpata; Integripalpia:
Imania sichotalinensis, Ecclisomyia kamtshatica,
Apatania sinensis, A. complexa, A. crymophila, A. zonella,
Neophylax ussuriensis, Hydatophylax magnus, H. soldatovi,
Asynarchus amurensis, Pseudostenophylax ussuricus,
Goera parvula, Dinarthrodes elongatus, D. brevis (Martynov,
1934, 1935). Larvae of Anisocentropus pallidus and Ganonema
extensum live in warm streams and rivulets with a temperature of
20–27° at the end of summer, on detritus-covered bottoms (Levanidova,
1951:533). Larvae of Apsilochorema sutshanum have recently been
recorded from rivulets with stony bottoms in the vicinity of Vladivostok;
the species was also recorded from the banks of the Sitsa (Levanidova,
1961; Martynov, 1934:72); Psilotreta kisoensis was also recorded
(Lepneva, 1958b:915–917).

The rheophilic fauna of the mountain rivulets of the Maritime Territory is very rich, and there are numerous endemic forms and elements of the Japanese-Chinese fauna.

**Foothill rivers and rivulets with rapids.** Rivers and rivulets with rapids in foothills or in hilly landscapes have boulder, pebble or debris-sand bottoms; they are divided into calm areas and shoals; their water is transparent; the current is slow in the calm areas but is rapid in the shoals and rapids; these rivers thus contain a complicated system of different biotopes with an ecologically diverse fauna, especially of caddis flies. There are a few elements of the fauna of streams, and their lower reaches sometimes contain several species of rivers of the plains, but the streams of foothills contain a characteristic group of forms restricted to this type of stream; this group is called "tachypotamobionts" (Martynov, 1929:14; Lepneva, 1949:259–260). The best examples of this fauna are the species of the Biya River in the Altai foothills (Martynov, 1929:229–309; Lepneva, 1949:189–191).

119 A typical fauna is present in this river where it flows from a lake at an altitude of about 450 m. It differs sharply in species and numbers from the fauna of Lake Teletskoe and its small tributaries. The following stream elements are found in the Biya River near the lake (in some localities near the shore and in tributaries): Rhyacophila impar, Apatania stigmatella, Dicosmoecus palatus, Oligoplectrodes potanini, Lepidostoma hirtum and Mystrophora altaica, which is widely distributed in the river. Immediately after the outflow of the river from the lake, however, appear Arctopsyche ladogensis and Hydropsyche nevae, which do not occur in the lake or its tributaries; these species occur (in large numbers in some localities) throughout the Biya River from its outflow to the estuary; however, they are absent in the turbid water of the upper reaches of the Ob.

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* Species could be identified only rarely from collections of larvae as the larvae of most species are not yet known. The list of species following is based mainly on Martynov's identifications of adult insects collected in 1927.

Below the outflow appears a group of small species characteristic of the Biya, e. g., Hydroptilidae (Stactobiella biramosa, Padunia adelungi and P. lepnevae) and Psychomyiidae (Psychomyiella composita and P. minima); the larvae of these tachypotamobionts live on pebbles; the adults appear in large numbers concentrating on stones, shrubs and trees; they land on vessels and rafts. The tachypotamobionts of the Biya River include the larvae of Stenopsyche griseipennis which are absent in the tributaries of Lake Teletskoe and the lower reaches of the Biya. This species occurs in small numbers on the western boundary of its range. In the Biya River occur the following species, which are also characteristic of larger rivers in the plains: Diploglossa nylanderi, Agapetus sibiricus, Hydropsyche kozhantshikovi. In the lower reaches of the river, near Biisk occurs also Hydropsyche ornatula; Leptocerus annulicornis was found near the banks of the river.

The fauna of Trichoptera in the foothills of the Western Sayan, in the rivers of the Oya system (Tanzibei, Malyi Kebezh and Bol'shoi Kebezh) has a similar character. In the Eastern Sayan, a similar fauna occurs in the Mana River. In the small rivers of the Sayans occur the following stream elements: Rhyacophila impar and Mystrophora altaica; in the Mana River occur Rhyacophila sibirica and Rh. lata.* The larvae of Stenopsyche griseipennis were found in large numbers in the Tanzibei stream but they disappeared higher along the profile. They live on small stones or large pebbles. In the Malyi Kebezh and Bol'shoi Kebezh rivers, and in the Mana River, occur Arctopsyche ladogensis and Hydropsyche nevae; of the species characteristic of larger rivers, there is Hydropsyche ornatula in the lower reaches of the Bol'shoi Kebezh; in the lower reaches of the Mana River occurs Macronema radiatum and Brachycentrus subnubilus (Lepneva, 1948b:96; 1949:256—257).

In Ciscaucasia, the foothill rivulets with rapids include the Psekups River, which is a tributary of the Kuban. Larvae of Rhyacophila sp. (which belong to the stream fauna) occur at the banks of this brook in some places. The larvae of Psychomyia pusilla (to 400 specimens per $m^2$), Cheumatopsyche lepida and Hydropsyche sp. are typical elements of the bottom fauna of the brook; Hydroptila sp. and Agraylea pallidula are common in turbulent water.

**Large and small rivers of the plains.** The larvae of caddis flies are a constant, sometimes predominating, element of the bottom fauna of the large rivers of the Siberian and European plains; these faunas are distinguished by their uniform taxonomic and ecological composition; they have the same ecological appearance for hundreds of kilometers in these large rivers.

120 Stream elements are usually absent in these rivers; they occur only sporadically in tributaries with a regime like that of streams. The fauna of some Siberian and north European rivers include the species Arctopsyche ladogensis and Hydropsyche nevae, which are characteristic of the rivers of the southern Siberian foothills. The main faunas of these rivers, however, are potamobionts which are restricted to

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* Wrongly recorded as Rh. manuleata by Lepneva (1948b:68 and 1949:256).

large rivers in the plains; these forms occur in large numbers in some localities. Most of these potamobionts belong to the family Hydropsychidae; there occurs also one species (several in the Amur) of Polycentropodidae and one species of Brachycentridae. Species of Leptoceridae occur in some localities, at the banks, on stones and on the bottom; these species are lithophiles which inhabit also stony lacustrine littorals. The fauna of plant thickets is present in some localities (rarely in large streams); this fauna increases constantly when the stream becomes smaller and its current slower.

In the north of the Russian plains, the stream elements are represented in the upper reaches of the Pechora River only by Lepidostoma hirtum. Hydropsyche ornatula is distributed throughout the river; Brachycentrus subnubilus occurs in smaller numbers in the middle and lower reaches of the river; Neureclipsis bimaculata is found in some localities in the arms and channels of the river; Arctopsyche ladogensis and Hydropsyche nevae are mainly found in the upper and middle reaches of the river (Lepneva, 1953:187–192). In other northern rivers (Neva, Svir') both the preceding species occur in large numbers; in the lower reaches of the Svir' numerous adults of Arctopsyche ladogensis appear; numerous adults of Hydropsyche nevae appear every year at the beginning of summer in the Petrodvorets area; they cause inconvenience, and even harm, to the inhabitants (see p. 168).

The characteristics of the typical fauna of Trichoptera of large rivers were distinct along the Volga before its reconstruction; these characteristics are still recognizable in parts of the Volga which were not reconstructed. Stream elements were not found in the Volga; forms common to rapids and northern rivers are also absent. The most common potamobiont of the Volga is Hydropsyche ornatula, which has two generations as shown by Zarechnaya (1960); in some localities H. guttata occurs in small numbers; the larvae of Hydropsyche are distributed throughout the profile of the river; they occur mainly in the littoral stripe, on stones, tree-trunks with roots, branches, on clay bottom and sometimes in the burrows of the mayfly Palingenia; 12,800 larvae per $m^2$ of Hydropsyche ornatula were found in the middle reaches of the Volga, near Sviyaga, with a biomass of 41.24 $g/m^2$ (Zhadin, 1948:424); near the town Gorki (before building the dam) the numbers of Hydropsyche ornatula reached 3,810 larvae per $m^2$ (Gun'ko, 1955:7); up to 5,000 larvae per $m^2$ were found in the Volga near Kuibyshev (Lyakhov, 1957:118). In summer, Hydropsyche ornatula and the mayfly Polymitarcys virgo appear in masses; before the reconstruction of the Volga, caddis flies and mayflies appeared in summer along the whole river. Neureclipsis bimaculata occurred along the whole Volga, from its upper reaches, on tree trunks with roots, on sunken branches and among the vegetation; however, it occurred only sporadically, and in smaller numbers than H. ornatula. It occurs in large numbers in small tributaries of the Volga overgrown with vegetation (Figure 167, B); 146 larvae per $m^2$ were found on the bottom in the Sviyagi area. Brachycentrus subnubilus occurs mainly in the middle and upper reaches of the Volga. On the bottom, on stones or on tree trunks with roots at the banks of the Volga Leptocerus annulicornis occurs as it does also in the open littoral of lakes; sometimes, together with Neureclipsis
121 bimaculata, Oxyethira sp. and Orthotrichia tetensii occur in plant thickets (Bening, 1924:254–261; Lepneva, 1929b:155–161; Zhadin, 1948:423–424).

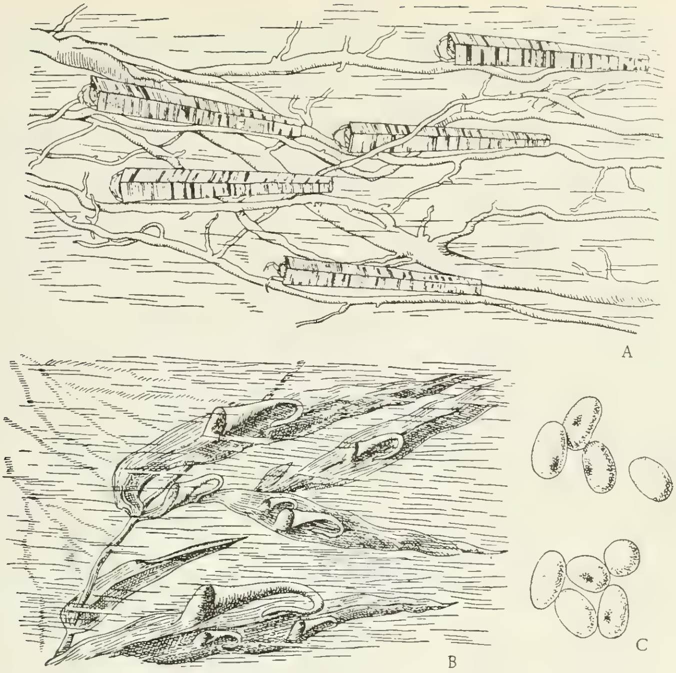

FIGURE 167. Potamobionts: larvae of Brachycentrus subnubilus in the current (A), nets of Neureclipsis bimaculata larvae in river plant thickets (B), eggs of Hydropsyche ornatula (C)

Potamobionts which occur in the Volga: Hydropsyche ornatula, Neureclipsis bimaculata and Brachycentrus subnubilus are also found in the Oka; H. ornatula predominates; Leptocerus annulicornis, which occurs in lakes, is found also on the banks of the Oka; the fauna of plant thickets is more abundant than in the Volga. In addition to the aforementioned potamobionts, there are Agraylea multipunctata, Ecnomus tenellus and Phryganea striata (Lepneva, 1925:124–127; Zhadin, 1940:866–892).

The same caddis fly fauna of the Volga was also found throughout the Kama before its pollution: (Hydropsyche ornatula, H. guttata, Neureclipsis bimaculata, Brachycentrus subnubilus); some of these species are still present in some parts of that river. Hydropsyche ornatula is distributed everywhere in parts of the river not silted or polluted; 265 specimens per $m^2$ were found above Okhansk in 1938, and 332 specimens per $m^2$ were found on stable bottom near Okhansk in autumn 1939 (Bening, 1928:270–272; Gromov, 1949:130; 1950:45–46; 1951:115; Lepneva, 1928a:25). Caddis flies completely disappeared, or their numbers decreased markedly in some localities, after the obstruction and pollution of the river (Gromov, 1954:9–10).

122 The potamobionts Hydropsyche ornatula, Neureclipsis bimaculata and Brachycentrus subnubilus predominated in the large tributaries of the Volga and Kama, e. g., the Mologa, Sheksna, Sura,

Belaya and Sylva, when they had their natural character. In other, smaller tributaries of the Volga, N. bimaculata or B. subnubilus predominated. Large numbers of Brachycentrus subnubilis were observed in the past in many localities in the Sheksna. Neureclipsis bimaculata occurs in large numbers on Potamogeton in a small tributary of the Volga near Saratov (Bening, 1924:256; Lepneva, 1928b:49–51; 1929b:161–162).

The caddis fly fauna is more diversified in the Dnieper, the largest river of the southern European USSR. Before reconstruction, the stream form (Hydropsyche angustipennis) occurred in rapids, and two forms which occur also in rapids in Ciscaucasia: Hydroptila emarginata and Psychomyia pusilla. Hydropsyche ornatula predominates throughout the course of the river; large numbers also occurred in the rapids of the Dnieper in the past; hundreds of larvae were found in one sample from the rapids; 833 specimens were counted on the surface of a stone with an area of 625 $cm^2$ (Beling, 1939:19). Hydropsyche was also found in large numbers further upstream, in the middle reaches of the Dnieper, where 480 larvae of Hydropsyche and 2 larvae of Neureclipsis bimaculata were collected from a small branch 22 cm long (Zhadin, 1940:653). Hydropsyche guttata, Neureclipsis bimaculata and Brachycentrus subnubilus occur in much smaller numbers in the Dnieper; these three species were very constant in the former rapids. Among the forms which also occur in lakes, Leptocerus excisus, L. fulvus and L. senilis were found near the banks on stones and on the bottom; Agraylea pallidula, Orthotrichia tetensii, Ecnomus tenellus and Cyrnus flavidus were found in plant thickets in some localities. The rheophilic fauna of caddis flies of the Dnieper disappeared from the reservoir (Beling, 1939:18–38; Zhadin, 1940:654–664; Zhuravel', 1934:53; Lepneva, 1932:75–94).

Two stream forms, Rhacophila nubila and Hydropsyche angustipennis, were found in the Southern Bug; of the forms characteristic for rivulets in Ciscaucasia, Hydroptila emarginata and Psychomyia pusilla occur also in the Dnieper, and Cheumatopsyche lepida is widely distributed in the Southern Bug. The most common species are Hydropsyche ornatula, Neureclipsis bimaculata and Brachycentrus subnubilus. Leptocerus annulicornis and L. senilis occur on the bottom near the banks; Agraylea pallidula, Ecnomus tenellus, Setodes tineiformis and Mystacides longicornis occur in plant thickets (Lepneva, 1932:75–96).

In the rivers of the Don basin, the potamobiont species are gradually replaced by phytophilic forms. In the unchanged parts of the Don, where the current becomes slower and the vegetation is more developed, the potamobionts Hydropsyche ornatula, Neureclipsis bimaculata and Brachycentrus subnubilis predominate; they were previously distributed throughout the river. They are mainly found on stones under steep banks, where the current is 0.5–0.7 m/sec, and in parts with a solid clay bottom; Neureclipsis bimaculata and Brachycentrus subnubilus were also found in the Don on sand and silt soils, where they attached their cases and nets to tree trunks and shells. Leptocerus fulvus occurs in some localities on the bottom near the banks; Ecnomus

123 tenellus occurs on tree trunks with roots. The phytophilic forms in plant thickets are: Orthotrichia tetensii, Cyrnus flavidus, Triaenodes bicolor, Setodes tineiformis, Mystacides longicornis, Leptocerus aterrimus, Agrypnia pagetana and Phryganea grandis. The potamobionts Hydropsyche ornatula and Neureclipsis bimaculata occur in the Voronezh River with its more abundant plant thickets (Bukhalova, 1937:35; Saint Hilaire and Bukhalova, 1937:75).

Potamobionts are less common in the Northern Donets, some areas of which form a transition between running and stagnant water with plant thickets which fill almost the whole profile of the river and with a very slow current. Hydropsyche ornatula was not found during a systematic study of the river in 1924–1926; single specimens of H. guttata were found. Brachycentrus subnubilus and Neureclipsis bimaculata are also not common in this river, but N. bimaculata occurs in large numbers in channels with a rapid current and continuous plant thickets. The following phytophilic species predominated in the Northern Donets: Hydroptila femoralis, Orthotrichia tetensii, Oxyethira sp., Cyrnus flavidus, Leptocerus aterrimus, Setodes tineiformis, Triaenodes bicolor, Phryganea grandis, Agrypnia pagetana. Where the current becomes slow, its caddis fly fauna is very similar to the lacustrine fauna (Lepneva, 1929).

Like other rheophilic Trichoptera, potamobionts are absent in marshy, slowly flowing rivers and rivulets in the low Meshchera plain; the caddis flies in plant thickets of these rivulets are the same as in lakes; Triaenodes bicolor and Oecetis lacustris are common, Ecnomus tenellus also occurs, Molanna angustata and Phryganea striata occur more rarely (Lepneva, 1929a:6–9).

Beyond the Urals, the species of potamobionts of the large Siberian rivers change from west to east; Siberian and Japanese-Chinese elements become more numerous, and the European forms become rarer and gradually disappear or are represented by isolated forms.

The faunistic border between the Biya with its clear water and the Ob with its turbid water is rather sharp. Arctopsyche ladogensis and Hydropsyche nevae, which are characteristic for the Biya, do not occur in the upper reaches of the Ob; Hydropsyche ornatula occurs there, but not in such large numbers as in European rivers, Neureclipsis bimaculata is rare, Brachycentrus subnubilus is common in some localities, and occurs in large numbers. The Siberian potamobiont Cheumatopsyche czekanowskii appears; among the potamobionts of the Ob, species of Macronematinae predominate, e. g., Macronema radiatum and Aethaloptera rossica, which fly in large numbers above the water in summer. Larvae of Mystacides sp. and Triaenodes interna are found in some localities on the riverbanks (Lepneva, 1930:156–163; 1948:96–98; 1960:175).

Hydropsyche ornatula predominates in the lower reaches of the Irtysh; large numbers of larvae are found on the bottom, especially on clay bottoms. Brachycentrus subnubilus is found mainly on tree trunks with roots and sunken branches, sometimes in large numbers.

Neureclipsis bimaculata is found more rarely, and Macronema radiatum was not found in the Irtysh. Aethaloptera rossica was found only in the upper reaches of the river, near Semipalatinsk, where it occurred in large numbers (Martynov, 1934:303–304; Fridman, 1937:203–211).

Species which occur also in rivulets in the foothills are common on the bottom of the Yenisei, with its rapid current and its numerous rapids; this also applies to Arctopsyche ladogensis and Hydropsyche nevae, which are distributed in small numbers to Stony Tunguska. From the village Oznachennyi to the estuary of the Angara, 2–4 specimens per $m^2$ of H. nevae were found; further downstream, to Stony Tunguska, only 0.9 specimens per $m^2$ were found.

124 Among the stream elements, single specimens of Rhyacophila impar and Lepidostoma hirtum were found on the banks of the river. Neureclipsis bimaculata does not occur in the Yenisei; larvae of Hydropsyche ornatula and Brachycentrus subnubilis have been found in the upper, middle and lower reaches of the river, to Igarka and Kureika. The following Siberian and Far Eastern potamobionts predominate in the Yenisei: Hydropsyche kozhantshikovi, Cheumatopsyche czekanowskii, Macronema radiatum and Aethaloptera rossica. Only single specimens of H. khozhantshikovi reach the estuary; the other species reach the Lower Tunguska. On stones near the banks of the river occur: Apatania sp., Leptocerus annulicornis, L. excisus, Goera sajanensis (Greze, 1957:155–156; Lepneva, 1948b:67–97; 1949:255–261; Pirozhnikov, 1929:68–72).

The fauna of Trichoptera of the Amur is very characteristic, both in its large numbers and in the occurrence of a number of species which occur only in this river. The larvae of these species have been little studied; none of the three typical potamobionts of European rivers were found in the Amur. Identification of adult insects showed that the group of potamobionts of the Amur consists of 9 species of Annulipalpia, including 2 species of Polycentropodidae not known from other localities (Hyalopsyche amurensis and Neucentropus mandjuricus), Arctopsyche amurensis, Cheumatopsyche chinensis, Ch. albofasciata, the widely distributed Ch. czekanowskii and 3 species of Macronematinae: Amphipsyche proluta, which is common in the Amur, the very common species Aethaloptera rossica, and the less common Macronema radiatum. The last 4 species are known from the Amur also as larvae; especially numerous larvae of Aethaloptera rossica were found in the stomach of fish. The water temperature in the habitats of the larvae reaches 22–23.6° in summer; the number of larvae of Aethaloptera rossica reaches 180–266 specimens per $m^2$; in some localities, that of Amphipsyche proluta to 40 specimens per $m^2$. Larvae of Hydropsyche sp. have also been recorded from the Amur; larvae of Oecetis sp. and Leptocerus excisus (Leptoceridae) were found on the banks of the river (Klyuchareva, 1952:362–367).

### Reservoirs

The building of a reservoir slows the current of a river, disturbs the hydrological regime of the river section and changes the character of the bottom and the life conditions of the bottom organisms; the whole lithorheophilic fauna disappears, including the potamobionts. Neureclipsis bimaculata is the most tolerant of the potamobionts; this species develops in large numbers in parts of the river which have retained their original current, e.g., near the inflow into the Tsimlyanskii Reservoir.*

The new fauna of Trichoptera of reservoirs consists of the fauna of the riverbanks and plant thickets; some of the most eurytopic species are able to live in water reservoirs. On the other hand, species which were rare and represented by isolated specimens in rivers may develop abundantly in reservoirs, e.g., larvae of Ecnomus tenellus and Oecetis sp. Some of the limnophilic species of reservoirs enter from the river floodland or from lakes.

From the Rybinsk Reservoir, which was built in 1941, there have been 26 species of caddis flies recorded, including Agraylea multipunctata, Neureclipsis bimaculata, Cyrnus flavidus, Ecnomus tenellus,
125 Agrypnia pagetana and 3 species of Oecetis (O. furva, O. lacustris, O. ochraceae), Leptocerus senilis, Triaenodes bicolor, Mystacides longicornis, Molanna palpata (Zarechnaya, 1959a:179–186).

Limnophilus rhombicus and Oecetis ochracea were found in the Ucha Reservoir. Large numbers of Ecnomus tenellus occur in small reservoirs in the Krasnodar Territory, e.g., in the Tshchikskoe Reservoir; this species is common in small reservoirs also in other localities. Large numbers of Oecetis ochracea occur in the Shapugskoe Reservoir.

Cyrnus flavidus, Ecnomus tenellus, Triaenodes bicolor, Oecetis lacustris, Mystacides longicornis and Molanna angustata occur in a small reservoir on the Embulatovaka River, tributary of the Ural River in the Ural Region in West Kazakhstan. In the Farkhad Reservoir of Middle Asia Ecnomus tenellus predominates; Oxyethira sp. and Agraylea pallidula predominate in plant thickets.

Of the rheophiles which were found in the Oredezha River before the dam was built, the following species disappeared from the small Vyritskoe Reservoir: Rhyacophila nubila, Plectrocnemia conspersa, Neureclipsis bimaculata, Hydropsyche pellucidula, Chaetopteryx sahlbergi, Lepidostoma hirtum, Brachycentrus subnubilus, Sericostoma personatum and Goera pilosa; Polycentropus flavomaculatus and Potamophylax stellatus did not disappear. Of the species living in plant thickets and parts with a silt-sand bottom, the following species remained in the reservoir: Ithytrichia lamellaris, Cyrnus flavidus, Holocentropus picicornis, Molanna angustata, Phryganea striata, Limnophilus rhombicus, L. flavicornis and Grammotaulius atomarius; Oecetis furva and Nemotaulius punctatolineatus appeared again (Shcherbina, 1958:95–96, 104–105).

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* According to Ts.I. Ioffe.

Stagnant water

Integripalpia predominate in stagnant ponds; Annulipalpia are represented by a few species of Hydroptilidae and Polycentropodidae and have a secondary position.

**Lakes.** The character of the biotopes of lake bottoms and of their population is determined by the soil of the bottom, the food available and the condition of the water; very mobile (in the surf zone), slightly mobile (in plant thickets and in the sublittoral) or almost stagnant (in the region of silt deposits, the profundal region).

Conditions in parts of the open stony littoral resemble those in mountain streams and brooks; there is the same rocky, boulder-covered bottom or bottom formed of stone fragments, with rich food in the form of detritus algae and microflora, and with numerous biotopes suitable for bottom animals, including caddis fly larvae. In the sandy littoral the larvae remain at a certain depth if the silting is weak and there is plenty of detritus and little mobile water; in plant thickets, the larvae crawl on plants, swim among stalks and leaves and live among plant remains on the bottom.

In the north and northwest of the European USSR, in the large oligotrophic lakes of Karelia (Ladoga, Onega, and Segozero), one frequently finds rheophilic species which occur also in brooks and streams, in biotopes in the stony littoral, especially Rhyacophila nubila, Hydropsyche angustipennis, H. pellucidula, Polycentropus flavomaculauts and Potamophylax stellatus, and also Apatania wallengreni, Leptocerus cinereus, L. excisus, L. annulicornis, Chaetopteryx sahlbergi. In parts with a moderately strong surf, Leptocerus aterrimus, Goera pilosa and Lepidostoma hirtum occur; in overgrowths of diatoms one commonly finds larvae of
126 Leptocerus fulvus and L. senilis. The species Molanna (M. angustata, M. palpata, M. submarginalis), Molannodes tincta, Mystacides azurea, Anabolia soror, Oecetis ochracea and Oe. lacustris are characteristic for biotopes of the sandy littoral, at a depth of 0.5–1.5 m. In plant thickets one constantly finds Hydroptilidae (Agraylea multipunctata, Oxyethira distinctella, O. costalis and Orthotrichia tetensii); Cyrnus flavidus and Holocentropus picicornis are common in plant thickets; Triaenodes bicolor and Mystacides longicornis (Leptoceridae) are common; Leptocerus aterrimus is common; Phryganea striata, Agrypnia obsoleta, A. pagetana, rarely A. varia (Phryganeidae) are common. Among the Limnophilidae, one regularly finds Nemotaulius punctatolineatus, Grammomotaulius atomarius, Limnophilus nigriceps, L. decipiens, L. politus, L. rhombicus, more rarely L. borealis and L. flavicornis; the species of Molanna and Oecetis, found in the sandy littoral, occur also on the weakly silted bottom of open plant thickets. These species, and also Cyrnus flavidus and Mystacides azurea, occur regularly in the sublittoral; isolated specimens occur in the profundal zone to a depth of 10–20 m (Lepneva, 1928:115; Sokolov, 1956:79–87; Gerd, 1949:48–83).

In the mesotrophic and eutrophic lakes of the leveled glacial landscape of the Baltic and Leningrad regions and the Valdai Upland, an open surf littoral is often absent or represented by isolated boulders, parts of open clay coast or small sand beaches surrounded by plant thickets. Rheophilic forms are absent in these lakes; among the lithophilic forms, Cyrnus flavidus, Leptocerus cinereus, L. fulvus, L. aterrimus and Limnophilus (nigriceps and politus) occur rarely on stones and on clay; Molanna angustata, Anabolia soror, Mystacides azurea and Oecetis ochracea are common on sand bottoms; the northern species Molanna palpata does not occur there, however. A fauna of plant thickets resembling the preceding fauna predominates, but it is usually not so rich. Among the Leptoceridae, Setodes tineiformis is common, sometimes very numerous; the most common species of Phryganeidae is Agrypnia pagetana (Kachalova, 1955).

Only isolated larvae of Trichoptera are found in dystrophic lakes.

On the rocky shore of the open littoral of the large ultra-oligotrophic Teletskoe Lake in the Altai, isolated larvae of Apatania stigmatella and young larvae of Dicosmoecus palatus are found; the same species are found in larger numbers on stones on the boulder-covered shore or in rock screes, where large populations of Dicosmoecus palatus, Asynarchus lapponicus, Anisogamodes flavipunctatus, Limnophilus sibiricus and Lepidostoma hirtum occur frequently in the northern part of the lake with a moderately strong surf. The large, sand or pebble-covered beaches are without any macrofauna; in more or less calm areas of sand and pebbles, isolated specimens of species are found as they are also on stones, i.e., Apatania stigmatella, Annitella obscurata and Limnophilus sibiricus. The fauna of plant thickets is poor, including isolated specimens of Mystacides longicornis and Limnophilus nigriceps.

At a depth of 10–20 m, in addition to forms which entered accidentally from the littoral, larvae of the Siberian species Mystacides dentata, which is a vicarious species of the European Mystacides azurea, characterize the sublittoral of the Altai lakes (Lepneva, 1949:186–189).

The larvae of Apatania stigmatella, Dicosmoecus palatus, Anisogamodes flavipunctata, Goera sajanensis and Mystacides dentata are the main species in the lakes of the Katun Alps. Dicosmoecus palatus is represented by isolated specimens in the lakes of the Chul'cha River basin; the faunas of Trichoptera in these lakes consist of common Palearctic forms such as Molanna palpata, which is widely distributed in Siberia, and Mystacides longicornis, Agrypnia obsoleta, Limnophilus nigriceps and L. stigma. The fauna of Trichoptera of small mountain lakes in the vicinity of Lake Teletskoe consists only of the above Palearctic species together with Phryganea striata, Nemotaulius punctatolineatus, Limno-
127 philus rhombicus, L. politus, and also of the Siberian species Goera sajanensis (Lepneva, 1933:145–146, 157; 1935; 1950:123–125).

The littoral of the open Lake Baikal and its wide inlets is inhabited by species of Baicalina, Thamastes, etc., which belong to the endemic tribe Baicalini Mart. (= Thamastini Schmid), and by several species of Apatania which are also endemic. The upper two meters of stones subjected to the action of strong breakers are little populated by Trichoptera; deeper in the 2–4 m region, larvae of Baicalina bellicosa, B. spinosa, B. thamastoides and Thamastes dipterus are abundant;

these larvae sometimes cover the stones completely. The larvae of Baicalodes ovalis live at greater depths, preferring small stone screes; they are present in large numbers only in the 8–10 m zone; the larvae of Baicalinella foliata prefer a sandy bottom; Apatania baicalensis prefers a sand-clay bottom in the 2–10 m zone, rarely in the 10–30 m zone; in all these biotopes and depths the larvae find abundant and very nutritive food in the overgrowths of algae, fungi and bacteria.

The pupae of Thamastes dipterus climb in spring from the water through cracks in the ice before all other species; adults of this species do not fly but run on the water and on ice, concentrating sometimes on stones on the shore close to the water. Other species fly in large numbers, but scatter higher and more widely in the coastal zone, covering the branches of trees to a height of 10 m; the flight of these species is described below (p. 167).

The endemic forms of Lake Baikal predominate in open and wide bays; however, together with this fauna appear other common species. For example, in the Anga inlet, the entrance of which is 1.3 km wide, occur Thamastes dipterus, species of Baicalina (B. thamastoides, B. bellicosa, B. spinosa), Baicalodes ovalis and Baicalinella foliata; in various biotopes occur also the common Palearctic species Agrypnia obsoleta and Molanna palpata. In the Posol'skoe salina, which is an inlet separated from the sea by a sand bar, the only Baikal element (represented by isolated specimens) is Apatania baicalensis; the main faunas of caddis flies of the inlet consist of common Palearctic and Siberian species, including Nemotaulius punctatolineatus and Molanna palpata. In the Kurkut inlet of the Maloe More (lesser sea) the only Baikal species are isolated specimens of Baicalinella foliata; the lacustrine forms of Siberia are represented by the species Agrypnia obsoleta, Phryganea striata, Ph. rotundata, Molanna palpata, Leptocerus annulicornis, Mystacides longicornis, Oecetis ochracea and Limnophilus nigriceps (Bebutova, 1941:84–88; Levanidova, 1946).

The characteristic fauna of Trichoptera of the Aral Sea (salinity 10.1 ‰) consists of two species which tolerate a high salinity, Agrypnetes crassicornis and Oecetis intima, which are widely distributed in this lake. O. intima occurs also in the Mertvyi Kultuk Bay of the Caspian Sea (Bening, 1934:194; 1937:172; 1940:95–96; Khusainova, 1959:10).

**Ponds.** Trichoptera are absent in young ponds as well as in old "decaying"* ponds, especially in ponds covered with Lemna with hydrogen sulfide near the bottom. Isolated specimens, or small numbers of species found in lakes, occur in ponds which are at least partly ventilated by photosynthesis or by the inflow of fresh water from a source; some of these forms are very abundant. The ecological characteristics of caddis flies
128 of ponds are determined by the water source and the regime of the ponds. In small trout ponds with a solid bottom on the fishery farm "Ropsha" (Leningrad Region), which are fed by cold water from the large limnocren Iordan', occur the lithophilic larvae of Apatania sp., Potamophylax stellatus and Chaetopteryx sp., which occur also in the limnocren.

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* In "moribund" ponds, according to the classification of Lukin (1954:96–101).

In the well-warmed ponds of the fishery farm "Puiga" (Kalinin Region) one finds large numbers of only the common phytophilic species, Nemotaulius punctatolineatus; this species covers its case with the large spheres of Nostoc which develop in masses in these ponds (Figure 112, B). The larvae of Ecnomus tenellus, Oecetis furva and rarely of Limnophilus decipiens occur in ponds of the fish nursery "Goryachii Klyuch" in the Krasnodar Territory, which receives its water from the Psekups River.

In small permanent ponds (either artificial or formed in floodlands) isolated species frequently occur or 2 to 3 common limnophilic species; characteristic forms of puddles occur in the dry parts of these ponds (see below, p. 122).

In large ponds resembling lakes with zones of plant thickets and parts with a free bottom, the fauna of caddis flies is more diverse and resembles the lacustrine fauna. The following species occur in plant thickets in such ponds in the European USSR: Agraylea multipunctata , Oxyethira sp., Cyrnus flavidus, Phryganea striata, Ph. grandis, Mystacides nigra, Triaenodes bicolor, Setodes tineiformis (the last two species sometimes occur in large numbers), Leptocerus senilis, Nemotaulius punctatolineatus, Limnophilus nigriceps, L. rhombicus, L. politus; Molanna angustata is rare in very large ponds, on sandy or slimy parts of the bottom. The preceding list is much larger than the number of species found in a single pond; there are usually only 5 or 6 species in a pond. The caddis fly of ponds is much poorer than the lacustrine fauna and is not original (Deksbakh, 1931:10; Zakharenko, 1955:7–11; Lepneva, 1925:128–129; 1928b:47–51; 1929:608).

**Puddles and ditches.** Spring puddles formed by snow, rain or floodlands are temporary and shallow and dry in summer; they sometimes form again in autumn; they freeze in winter. During their short existence, the conditions in these open, well-illuminated and warmed water bodies with their abundant food supply are nearly optimal for many limnophilic forms; the water temperature of the puddles rises above 20° in April in temperate latitudes; it reaches 21–22° in early May; the oxygen content of parts with green vegetation is usually higher than normal during the day.

Puddles have a characteristic fauna (Lukin, 1954:90–92). Caddis flies are not the most typical elements of the fauna, but they are represented in puddles by several species which are characteristic for temporary water bodies; they have a short metamorphosis which enables them to complete their development during the short existence of the puddle. The four small species of Limnophilus: L. centralis, L. griseus, L. sparsus and L. vittatus constantly occur in puddles in the European USSR in spring; their larvae have smooth, slightly curved cases of sand or fine detritus; L. vittatus is especially characteristic of puddles. In puddles with a rich green vegetation, one usually finds in spring large larvae of L. stigma with their large cases covered with plant particles arranged transversely and projecting laterally; these larvae are already near pupation in the first
129 half of May; in the rich aquatic vegetation of meadow puddles, one finds in spring, together with L. stigma, the large larvae of Grammotaulius

signatipennis; the pupae of this species swim on the water; the flight of G. signatipennis ends in the second half of May, and the empty cases float on the water.*

The species characteristic for puddles occur also in other water bodies, if the conditions are favorable; the four species of Limnophilus mentioned above usually occur separately in shallow ponds, especially in parts which dry up; L. stigma is common in plant thickets in lakes, where the outer cover of the case is often not so complex; Grammotaulius signatipennis also occurs in lakes.

In addition to the typical species of puddles, there occur in them "stray" species which are not adapted to life in temporary water bodies; e. g., the river forms Hydropsyche ornatula and Neureclipsis bimaculata, which are carried by the high water and which die rapidly in puddles; the limnophilic species Triaenodes bicolor, Oecetis ochracea, Limnophilus rhombicus, L. flavicornis, L. politus, Agrypnia obsoleta occur in puddles, as well as several other species which do not always complete their development before the puddles dry up (Greze, 1929:42–44; Zakharenko, 1951:151–152; 1955:5–6; Lepneva, 1925:126–129; 1928b:50–52).

Canals and ditches filled temporarily with snow or rain water dry up in summer; some of the typical forms or some of the "stray" forms occurring in puddles may be found in them in spring. Numerous, almost full-grown larvae of Ironoquia dubia (= Caborius dubius) are found regularly in the canal along the Moscow-Leningrad Highway (Kalinin Region) in early May. These larvae become rare in the middle of May and disappear toward the end of May. This species does not occur in typical spring puddles, being attracted to canals (also drainage canals) by their slow, sometimes temporary, current.

Drainage canals have a different character; they are shallow and have a constant water supply and the current may be slow. They also dry up partly in late summer and contain dry, humid and water-filled sections. The most characteristic Trichoptera in drainage canals are species of Phryganeidae such as Neuronia ruficrus and Oligostomis reticulata, which are restricted to turfy waters; these species occur in canals in fall, winter and spring. The adults of O. reticulata have variegated wings, those of N. ruficrus, uniformly dark wings. Large numbers of these species occur among leaves of shrubs and trees on the banks of turfy canals and rivulets in spring.

## IMPORTANCE OF THE STAGES OF DEVELOPMENT FOR THE SYSTEMATICS AND PHYLOGENY OF TRICHOPTERA

### Classification

The characteristic structures of caddis flies have attracted attention for a long time. We do not know whether Aristotle knew the imagines of
130 caddis flies, but he knew the larvae, which he called "wooden aquatic worms."

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* According to my observations near the biological station "Zaluch'e" in the Kalinin Region.

Ulmer's bibliography[*] lists 10 publications from the 18th century and the first quarter of the 19th century, which contain data on the larvae of caddis flies, e. g., the work of Reaumur (1737:196–204). Kirby (1815, p. 88) said in a footnote that the order Trichoptera is an independent taxonomic unit.[**]

Pictet (1834) published the first monograph on Trichoptera (including all stages of development); his descriptions are accompanied by color plates illustrating oviposition, larvae, pupae and imagines; some of Pictet's drawings have not lost their value to the present, especially the color plates showing live larvae and the building material of their cases.

Kolenati (1848:30–35; 1859:171, 182) described genera and species of caddis flies; he divided the order into 2 artificial groups according to the character and number of segments of the maxillary palps; this classification was based on the fact that males and females of the first group have a different number of segments of the maxillary palps (2, 3 or 4 segments in the males, and 5 segments in the females) while the number of segments of the maxillary palps of males and females is the same in the species of the second group, 5 in both sexes.[†] Later authors considered these groups as the suborder Inaequipalpia Kol. and Aequipalpia Kol.; these suborders are retained even in some recent publications.

Kolenati gives diagnoses of the suborders Inaequipalpia and Aequipalpia in Latin, including adults, larvae and pupae.

McLachlan (1874–1880; 1884) published a large monograph on Trichoptera in the 19th century. He enriched our knowledge of the Trichoptera of the world by numerous descriptions of new species; he also critically examined old descriptions, established synonymies and worked out a well-substantiated classification. The classical work of McLachlan is a milestone between the old and new taxonomy of Trichoptera, and determined the trend for improvements of the system.

McLachlan accepted the division of the order into the suborders Inaequipalpia Kol. and Aequipalpia Kol. with 3 families in the first suborder (Phryganeidae Burm., Limnophilidae Kol. and Sericostomatidae Steph.) and 4 families in the second (Leptoceridae Leach., Hydropsychidae Curt., Rhyacophilidae Steph. and Hydroptilidae Steph.). McLachlan divided the large
131 families, which had been sufficiently studied, into sections, e. g., the large family Hydropsychidae (including most of the future Annulipalpia Martynov, 1924) into 5 sections. He recorded one character common to all members of this group, the presence of an elongate, flagelliform, last palpal segment with numerous transverse divisions, and wrote (1874–1880:349): "The Hydropsychidae form a very numerous family, made up of incongruous materials, but all agreeing in the peculiar formation of the terminal joint of the palpi, which character separates them at once from all others." This penetrating taxonomist thus predicted the unification of the preceding groups into the suborder Annulipalpia Mart.

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[*] See Ulmer's bibliography (1903:137–146) which includes works from 1730 to 1903 containing data on the early stages of caddis flies. Important bibliographies for the first half of the 20th century and before were published by Thienemann, 1905b:561–569; Siltala, 1907:615–624; Betten, 1934:419–473; Martynov, 1934:307–317; Nielsen, 1942:626–631; Ross, 1956:196–202.

[**] See Fischer's catalog (1960:1).

[†] In the first part of his work, Kolenati considered the Inaequipalpia and Aequipalpia as families: 1. Heteropalpoidea Kol. and 2. Isopalpoidea; in the second part, he renamed them Inaequipalpidae and Aequipalpidae; groups considered at present as families were treated by him as tribes.

When possible, McLachlan included in his descriptions material based on Pictet's, other authors' data, as well as his own material. McLachlan's scientific career lasted almost 40 years; in addition to work on the systematics and fauna of the order, he gave much attention to the larvae; among his first publications are two small articles devoted to the feeding of the larvae and the construction of their cases (McLachlan, 1863; 1864). He also published a number of articles with descriptions of caddis fly larvae and their biology (McLachlan, 1867; 1869; 1872; 1874; 1879; 1881), and his paper on the behavior of the larvae of Phacopterys brevipennis (1902) was one of his last publications.

At the end of the 19th century and in the beginning of the 20th, publications on Trichoptera followed two trends: 1) further development of the systematics of the order and the division of the families established by McLachlan; 2) an intensive study of the pre-imaginal stages, mainly the larvae.

While McLachlan enlarged taxonomic units, Wallengren (Sweden, 1891) "split" taxonomic units in his large work on caddis flies.

Wallengren recognized 16 families instead of the 7 families of McLachlan (ibid., p. 12);* some of these families (most of them with a changed generic composition) have been accepted, but others were not accepted by later authors. Wallengren included data on the larvae in his descriptions and diagnoses whenever possible.

Klapálek in Czechoslovakia published 2 large works with descriptions of the larvae of a number of species (1888; 1893). In the introduction to the first publication, Klapálek (ibid., 1, Figures 1 and 2) divides the larvae
132 into campodeiform and eruciform larvae; this important generalization was the guideline for the later studies of Siltala, and for the establishment of the natural suborders by Martynov. Klapálek names the larvae of Philopotamus as examples of campodeiform larvae; these larvae have a long prognathous head and legs of almost equal size and similar form; they have deep constrictions between the segments of the movable, flexible abdomen and long, posteriorly directed anal legs. As an example of eruciform larvae, he cites the larva of Halesus; it has a hypognathous head, its legs are of different length and form, the constrictions between the segments of the massive, cylindrical abdomen are shallow; the larvae have a portable case and tubercles on the first abdominal segment. Klapálek later discussed systematic questions ((1903) 1904:8, 178–180);** he placed the Rhyacophilidae at the head of the list of the families; family Philopotamidae was placed second as he considered it a primitive family related to the Rhyacophilidae.

The larvae of Trichoptera were studied by Struck in Lübeck, Germany (1896; 1899; 1900; 1903). In his last article, this author arranged the figures in such a way as to offer their use to some extent as a key for identifying the larvae; other keys were not compiled until the publication of Ulmer's work (1903).

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* Inaequipalpia: Phryganeidae, Agrypniidae, Limnophilidae, Apataniidae, Sericostomatidae. Aequipalpia: Hydroptilidae, Beraeidae, Molannidae, Leptoceridae, Hydropsychidae, Philopotamidae, Psychomyiidae, Chimarrhidae, Crunophilidae, Glossosomatidae. Crunophilidae is a synonym of Rhyacophilidae, as already stated by McLachlan (ibid.).

** Previous authors quoted this work from the reprint (Klapálek, 1903:1–37).

Ulmer, Siltala and Martynov published their work on the larvae of caddis flies almost at the same time (1900—1902); Thienemann published his work on caddis fly larvae in 1903.

Martynov described the peritrophic membrane of caddis fly larvae and their glands in his first publications; he rarely described the larvae of Trichoptera in his later work, giving only some short descriptions of larvae occasionally (Martynov, 1901; 1903; 1926a:24—28, 31—33, 35—56; 1926c:291—292). He used the data which had accumulated to substantiate his new division of the Trichoptera into suborders (Martynov, 1924a:18—19).

Ulmer studied the larvae of Trichoptera for 10 years;* later he also published keys and surveys (Ulmer, 1912a; 1925a; 1927); the 2 volumes of his monograph contain numerous descriptions of larvae (Ulmer, 1955, 1957).

On the basis of his material (about 80 species) and on that of Struck, Klapálek, Morton and Siltala, Ulmer published a large survey of the caddis fly larvae of Europe; this work contained a detailed morphological section, keys and an exhaustive bibliography (Ulmer, 1903). The work is based on the division of McLachlan's 7 families into different groups, replacing McLachlan's sections with subfamilies which are based also on the morphology of the larvae; the family Limnophilidae was divided into the subfamilies Limnophilinae and Apataniinae; the family Sericostomatidae was divided into the subfamilies** Sericostomatinae, Goerinae, Brachycentrinae and Lepidostomatinae; the family Leptoceridae was divided into the subfamilies Beraeinae, Molanninae, Odontocerinae and Leptocerinae; the family Hydropsychidae
133 was divided into the subfamilies Hydropsychinae, Philopotaminae, Polycentropodinae† and Ecnominae. Some of these subfamilies correspond to the families of Wallengren; this detailed classification was also applied to the larvae.

It is no accident that the division into the artificial suborders Inaequipalpia and Aequipalpia does not appear in Ulmer's book (1903); he was an expert on caddis fly larvae, and it is impossible to give a diagnosis of these artificial groups for the larvae. In his key to families and subfamilies, Ulmer (1903:30—33) divides the order according to the larvae into the natural groups established by Klapálek, namely campodeiform and eruciform larvae; he placed the group of suberuciform larvae between them; Ulmer attempted to maintain, as far as possible, the system accepted in his time for the adult caddis flies; therefore, he accepted the same sequence of families as McLachlan, from Phryganeidae to Rhyacophilidae; he placed the third of the above groups at the head of his system, then the second and finally the first (Ulmer, 1903:30—31). The key to families based on the morphology of the larvae reflects the phylogenetic relationship of the groups better than keys of adults. Ulmer (1903:31) introduced an important correction into this key: he separated the family Leptoceridae with its eruciform larva from the families with campodeiform larvae, and placed it in its natural position in the group of families with eruciform larvae. The artificial classification of the Leptoceridae in the Aequipalpia Kol. was again stressed by Siltala.

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* Ulmer called this period "Meine Larvenperiode."

** Ulmer retains the classification of McLachlan.

† In this work, and in his later work (Ulmer, 1906, 1907) wrote Polycentropinae and Polycentropidae as he established this subfamily and family; later, taxonomists, including Ulmer, changed these names into Polycentropodinae and Polycentropodidae. We use these last names in the text and when we quote authors who did not use the names.

After Ulmer's classifications of 1903 and 1906, neither Thienemann nor Siltala described adult Trichoptera; the adults bred from larvae and pupae were identified by Klapálek and Ulmer. The study of the early stages of Trichoptera enabled them to establish the true phylogenetic relationship between some groups in some cases; this induced Thienemann to make some objections to the system of Ulmer of 1903, and later, also to Ulmer's revised system of 1906 (Thienemann, 1905b:542; Siltala, 1907:599—600).

After a number of short papers, Thienemann published (1905) a lengthy paper on the morphology and biology of the pupae (see p. 177). The material is arranged according to Ulmer's system (1903). Thienemann found some assumptions in this system which contradicted the natural relationships between the groups. He made some corrections of the system, based on the morphology and biology of the pupa; these corrections have been widely accepted. Thienemann (1905b:542—543) proposed the following changes.

1) To remove the subfamily Philopotaminae (genera Philopotamus and Wormaldia) from the family Hydropsychidae of Ulmer (1903), to consider it as an independent family, and to place this primitive family below the Polycentropodinae and Ecnominae of Ulmer. This was accepted in the later work of Ulmer.

134 2) To remove the subfamily Odontocerinae from the family Leptoceridae and consider it as the family Odontoceridae.

Thienemann is also of the opinion, on the basis of the morphology of the pupae, that the family Sericostomatidae is not homogeneous.

Ulmer accepted the foregoing suggestions; he published a system of 12 families (1906), which included the additional and following 5 families:* Molannidae, Odontoceridae, Calamoceratidae, Polycentropodidae, Philopotamidae.

The activity of the Finnish specialist of Trichoptera, Siltala, was very short (1900—1908)** but most productive. He published a series of interesting papers (1900—1905), describing intensively larvae and pupae of all families of the order occurring in Finland; he also dealt with the biology of these forms; from 1906 on, Siltala published his "Trichopterologische Untersuchungen," with large supplements on the morphology and biology of the order. Only 2 of these "Untersuchungen" were published (1906, 1907).

In the first of the "Trichopterologische Untersuchungen" Siltala (1906) drew interesting conclusions based on his observations of the egg masses of Trichoptera. He showed that the group of families with campodeiform larvae have egg masses arranged in rows or plates, consisting of an opaque viscous mass in which the eggs are arranged close to each other without any order; he also showed that families with eruciform larvae have egg masses which are surrounded by a transparent gelatinous mass swelling in water. Anticipating the generalizations of Martynov (1924), Siltala "made a reservation," considering the group of families with campodeiform larvae and egg masses of the first type as one of the "suborders"; he considered the group with eruciform larvae and gelatinous egg masses as another "suborder"; however, the artificial suborders of Kolenati were widely accepted until 1924 and neither Siltala nor other authors suggested abolishing them and replacing them with new ones. Siltala proved the existence of these new natural suborders also in the larvae and described them; however, he did this "by the way," not considering it an important taxonomic problem. This was repeated also in his latest work (Siltala, 1907:596). He understood that the suborders of Kolenati were artificial; he did not use them, but used his own views in the systematics of the order which he based on the biology of the larvae. This induced him, in 1906—1907, to introduce a division into suborders which was later established more definitely by Martynov (1924:18—20). Siltala thus anticipated the revolution in the system of caddis flies by Martynov (1924). This revision consisted of a division into natural suborders instead of the artificial division.

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* Quoted in the order given by the author.

** Siltala signed his works with the name Silfvenius, which is a "Scandinavized" pseudonym. From 1906 on, he signed with his Finnish name, Siltala. We use his true national name, according to his wish.

In the second of his "Untersuchungen," Siltala criticizes the artificial
135 suborders of Kolenati, stating decisively on the family Leptoceridae: "Die Leptoceriden, die mit den köcherlosen Formen, als Aequipalpia vereinigt werden, haben mit diesen nichts zu tun" (Siltala, 1907:606). The foregoing issue of the "Trichopterologische Untersuchungen" is a large work on the postembryonal development of caddis fly larvae, forming a supplement to the "Zoologische Jahrbücher" (Siltala, 1907). The major part of this work deals with the number of molts and the molting process of caddis flies, duration of the larval stages, respiration, feeding and movements of the 1st-stage larvae, construction of the case by the young larva; it also describes the cutaneous appendages of the larvae, divided by the author into "series with setae" and "series with spines"; he also describes the primary and secondary chaetotaxy.

This work deals with the postembryonal ontogenesis in a large group of families and subfamilies; it describes the characteristics and specialization of the primary chaetotaxy and the development of the secondary chaetotaxy in the different larval stages. Siltala gives a comparative-morphological survey of a number of larval structures, including gula, antennae, mouthparts, anal legs and primary and secondary chaetotaxy.

The author lists the families and subfamilies proposed by Ulmer (1906), but trying to find a natural order in the system, changes their sequence and places the group of families with campodeiform larvae before the group of families with eruciform larvae because he considers the former as more primitive. He arranges the families in each group from the most primitive to the most specialized; he places the families Rhyacophilidae to the Hydropsychidae in the group with campodeiform larvae; and the families Phryganidae to the Sericostomatidae in the group with eruciform larvae.

The marked resemblance between the 1st-stage larvae of the different families and subfamilies (especially the constant number and arrangement of the primary setae in the different groups) is considered an indication of their common ancestry by Siltala, and an expression of the unity of the group as a well-defined branch of the class Insecta. He proposed to determine the degree of primitivity or specialization of the various groups by the degree of resemblance or lack of resemblance between the full-grown larva and the young 1st-stage larva.

The author places the group of Trichoptera with campodeiform larvae (the future Annulipalpia Mart.) below the group with eruciform larvae (the future Integripalpia Mart.).

After examination of this rich material and study of the early stages of ontogenesis (which is very valuable for the solution of problems of phylogeny), Siltala discusses the phylogenies of a number of families and subfamilies; he compares the morphological characters of the specialized full-grown larva and the primitive 1st-stage larva.

The author places the family Rhyacophilidae lowest in the group of families with campodeiform larvae, because its primary chaetotaxy is almost unchanged compared with that of the 1st-stage, and its secondary chaetotaxy is little developed; he also stresses the high specialization of certain organs (anal legs).

The author places the Hydroptilidae next to the Rhyacophilidae (including Glossosomatinae) in spite of the special character of the full-grown larvae of
136 this family because the primary chaetotaxy (though highly specialized) persists during the entire larval life of Hydroptilidae, and because of the relatively poor development of the secondary chaetotaxy. The morphological characters of the free-living larvae of the first 4 stages of this family, which do not build cases and which have deep constrictions between the abdominal segments, resemble the typical campodeiform larvae of other families.

The author separates the Philopotamidae as an independent, very primitive family including the genera Philopotamus, Wormaldia and Chimarrha, on the basis of the morphology of the larvae; the primary chaetotaxy predominates in these genera; they have characteristic labrum, claws and structure of the anal legs in all 3 genera.

Siltala considers the composition of the family Polycentropodidae (according to Ulmer, 1906) as not sufficiently uniform according to the morphology of the larva; it is not correct in his opinion to unite the Psychomyiinae and Polycentropodiinae in one family, Polycentropodidae; he considers the Psychomyiinae, because of the prevalence of the primary chaetotaxy of the larva, as a more primitive group; this subfamily differs markedly from the Polycentropodiinae with their rich secondary chaetotaxy in the morphology of certain organs (even in the first stage).

Siltala places the family Hydropsychidae highest in the group of families with campodeiform larvae because of their characteristic structures, and their rich and highly differentiated secondary chaetotaxy; the full-grown larvae of this family differ markedly from the 1st-stage larvae.

Siltala places the family Phryganeidae lowest in the group with eruciform larvae; he considers this family as distinct from the Limnophilidae, and describes a number of primitive characters in the organization of the larva of Phryganeidae; he describes a certain resemblance to campodeiform larvae in a number of structures, e. g., the slightly elongate, not completely hypognathous head, the flattened abdomen with its deep constrictions between the segments, the little differentiated primary chaetotaxy and the little developed secondary chaetotaxy.

Siltala noticed the close relationship between the larvae of Leptoceridae and other eruciform larvae; he negated the close relationship between this family and other families with campodeiform larvae. He placed the family Sericostomatidae highest in the group with eruciform larvae. Among the subfamilies of Sericostomatidae he placed the subfamily Lepidostomatiinae; lowest (according to the morphology of the larvae). He noticed a certain resemblance between the larvae of this subfamily and those of the subfamily Goerinae on the one hand and family Limnophilidae on the other hand.

Ulmer ("Genera Insectorum," 1907:11—20) considered the Psychomyiidae as an independent family. He placed this rather primitive group between the Philopotamidae and Polycentropodidae (Ulmer, 1907:19—20, 191—254).*

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* In the key to the families and also in the text, the family Polycentropodidae is given number 9, the Psychomyiidae number 10, and the Philopotamidae number 11 (Ulmer, 1907:19—20); the numbers of the first 2 families are different on page 11, apparently because of a misprint.

Ulmer's work in "Genera Insektorum" (1907) is the last version of his classification, in which he still adheres to the traditions of the systematics of caddis flies of his time: the order is divided into the suborders Inaequipalpia and Aequipalpia. The artificiality of this division is even more evident because it now contains not one but 4 families with case-bearing larvae.

137 In an excellent work published in "Süsswasserfauna Deutschlands" Ulmer (1909) described the order in all stages of development (egg, larvae, pupae and imago) and gave his material in the natural order of the families, from Rhyacophilidae to Sericostomatidae. He did not use, as before, the artificial suborders proposed by Kolenati, but as in Siltala's classification, Ulmer placed the Psychomyiidae next to the Phylopotamidae.

Ulmer's classification (1907–1909) was widely accepted and was not changed for a long time. Martynov (1924:18–20) following Wallengren, proposed to consider the Beraeidae Wal. as an independent family; he added 2 new families: Stenopsychidae (separated from the Philopotamidae) and Arctopsychidae (separated from the Hydropsychidae). In his analysis of the Stenopsychidae, Martynov also briefly described its characteristic larva (Martynov, 1926b:291–292, Figures 9–14).*

The larva of Arctopsyche ladogensis was also described (Lepneva, 1928:28–32, Figures 1–11); the characters of this larva, which show that it is more primitive than the larvae of Hydropsyche, are a strong argument in favor of the independence of the family.

Martynov (1924:18–20) included the results of studies of the larvae of Trichoptera during the last 40 years. He replaced the old division into suborders by a new division. He stated (ibid., 18–19): "Kolenati (1848) divided all Trichoptera into two groups (this division was modified in 1859): Inaequipalpia, with an unequal number of segments of the maxillary palps of males and females; and Aequipalpia, with 5-segmented maxillary palps in both males and females. This division is artificial and does not agree with the conclusions of Klapálek and Siltala which were based on the study of the larva. Their study showed that the Trichoptera are already divided into 2 groups; 1 group has campodeiform larvae: (Rhyacophilidae, Hydroptilidae, Philopotamidae, Polycentropodidae, Psychomyiidae, Hydropsychiidae), the other has eruciform or suberuciform larvae (all other families). Great differences in the biology of these 2 groups of larvae were found. Ulmer also stated that the Trichoptera form 2 complexes of forms according to the larvae."

"The study of the wing venation, mouthparts and genitalia led to the conclusion that the adult Trichoptera also form 2 suborders as clearly as the larvae. The differences between these suborders are evident in the various systems of organs; all this shows that despite the sometimes close resemblance between the species of both suborders (which indicates parallel evolution), the differences between them are marked and ancient. As the last palpal segment is annulated in most groups of the first suborder,** I named this suborder Annulipalpia and the second suborder Integripalpia, because the last palpal segment is undivided. The Integripalpia show a close relationship to Lepidoptera."

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* This larva was described in detail by Lepneva (1948a).

** See p. 123.

138 The larvae of Annulipalpia are campodeiform; the larvae of Integripalpia are eruciform or suberuciform.

The classification of Martynov is as follows (Martynov, 1924:19—20; 1934:31):

| Suborder Annulipalpia | Suborder Integripalpia |
|---|---|
| 1. Rhyacophilidae. | 1. Calamoceratidae. |
| 2. Hydroptilidae. | 2. Odontoceridae. |
| 3. Philopotamidae. | 3. Molannidae. |
| 4. Stenopsychidae. | 4. Leptoceridae. |
| 5. Polycentropodidae. | 5. Beraeidae. |
| 6. Psychomyiidae. | 6. Sericostomatidae. |
| 7. Arctopsychidae. | 7. Phryganeidae. |
| 8. Hydropsychidae. | 8. Limnophilidae. |

In the Integripalpia, Martynov approximated the families Phryganeidae and Limnophilidae; however, he did not consider the primitive character of the larvae of the Phryganeidae and some of the larvae of the Limnophilidae, and placed them at the end of the list.

Martynov published his new suborders only in a footnote to one of his works (Martynov, 1930:65).

Martynov repeatedly discussed the phylogenetic relationships between groups of caddis flies, e. g., of the Apataniinae, Phryganeidae (Martynov, 1914; 1924b:209—224). In his surveys of the geological history and phylogeny of insect orders, he placed the origin of the Trichoptera in the Carboniferous and the divergence of the Annulipalpia and Integripalpia in the Permian, i. e., in an earlier period than the separation of Lepidoptera from the Integripalpia (Martynov, 1938; table).

The classification of Trichoptera remained without any important changes for 16 years after the publication of Martynov (1924), and his suborders and new families were widely, but not completely accepted (see footnote on p. 145).

A new stage of revision of the classification of Trichoptera began in the 1930's based on large collections from the tropics and subtropics. Of special importance for the study of the larvae was Snodgrass' book "Principles of Insect Morphology" (1935). The new material resulted in the appearance of valuable faunistic and systematic publications, raised the level of morphological studies, which resulted in a revision of the types established by the old authors* and a revision of systematic groups. The new period reached its peak in the years after the war. The preimaginal stages were more widely used for the solution of systematic and phylogenetic questions.

139 Ulmer entered this new period with his study of the Trichoptera of the Sunda Islands (Ulmer, 1951; 1955; 1957). The first part of the foregoing work is devoted to the adult Trichoptera, the second and third parts to larvae and pupae. His classification uses the suborders Annulipalpia and Integripalpia and the sequence of families adopted by Ulmer in his publications after 1906 (excluding families absent in the tropics and including one new family). The detailed descriptions of the larvae use recently introduced characters and are accompanied by numerous figures.

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* For example, the types of Navas were revised by Schmid (1949), McLachlan's types were revised by Kimmins and Denning (1951), and those of Walker by Betten and Mosely (1940).

The second large publication of the 1950's was the work of Mosely and Kimmins (1953) on the Trichoptera of Australia and New Zealand. The authors added 3 new families;[*] they dealt only with adult Trichoptera, except for 1 larva described by Ulmer (*Philanisus plebeius*). The work of McFarlane (1951) includes a description of the larvae of the subfamily Hydrobiosinae (Rhyacophilidae) which is richly represented in the Australian region; the publications of Kimmins (1959) and Neboiss (1957, 1962) on the adults of this subfamily supplement the work of Mosely and Kimmins.

The work of Mosely and Kimmins has a somewhat archaic appearance, as it gives the descending order of families in the suborders of Kolenati, Inaequipalpia and Aequipalpia.

In the first volume of his catalog of Trichoptera, Fischer (1960:1–2)[**] accepts the suborder Annulipalpia and Integripalpia as corresponding to modern knowledge. On the other hand, he states about the suborders of Kolenati: "Some names created for groups of families, not in accordance with the suborders now accepted" (Fischer, 1960:2).

The older division into suborders based on the larvae and pupae agree with recent systematics, which are based on phylogenetic relationships and not on a division of the order based on single character of the adult.

140 Navas (1924:1–2) stated that there are 1,600 species of Trichoptera. Fischer (1944:58–60) stated that there are 3,447 species[†] distributed among the families as follows:

| | | | |
|---|---|---|---|
| Philopotamidae ....... | 151 | Philorheithridae ......... | 4 |
| Stenopsychidae ....... | 43 | Odontoceridae ......... | 42 |
| Polycentropodidae .... | 236 | Molannidae ............. | 19 |
| Psychomyiidae ....... | 137 | Leptoceridae ............ | 478 |
| Hydropsychidae ...... | 587 | Phryganeidae ........... | 76 |
| Arctopsychidae ...... | 19 | Kitagamiidae .......... | 4 |
| Rhyacophilidae ..... | 358 | Limnophilidae ........... | 611 |
| Hydroptilidae ....... | 215 | Sericostomatidae ....... | 375 |
| Calamoceratidae ..... | 90 | Incerta sedis ........... | 2 |

The number of species recorded for the various families increased in the following years by the description of new species and decreased by synonymy. Fischer lists the following distribution of species, until 1938, in vol. 1 and 2 of the catalog: Rhyacophilidae[††] – 362 species; Philopotamidae – 151 species; Hydroptilidae – 208 species. He gives the following distribution of species in vol. 2 until 1940; Stenopsychidae – 47 species; he lists the following distribution until 1940 in vol. 3: Psychomyiidae – 142 species;[†††] Polycentropodidae – 229 species; he lists 646 species for Hydropsychidae and 20 species for Arctopsychidae in vol. 4 until 1944.

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[*] See p. 142.

[**] Volumes 2 and 3 of this catalog were published in 1961 and 1962 (Fischer, 1961, 1962), volume 4 in August 1963.

Fischer's catalog (Trichopterorum Catalogus) facilitated the study of the order. It will consist of 11 volumes and 4 supplements. Volumes 1–4 include the Annulipalpia; the literature published until 1938 is listed for most families; the literature until 1940 is given for the family Stenopsychidae; the literature for the Hydropsychidae and Arctopsychidae is given until 1944. Volumes 5–11 will include the Integripalpia and may include literature published from 1944–1957. Volumes 12–15 will contain supplements; they will include the literature until 1960. The catalog is planned to be completed in 1972.

[†] Fischer mentions in a table 3,702 species for the world fauna of Trichoptera (including recent and fossil forms); in another place he mentions 255 fossil species.

[††] Sensu lato, including the Glossosomatinae. The numbers indicate recent species; the fossil species quoted from Ross and Fischer's catalog have been excluded.

[†††] According to the classification in the present book, this includes the Ecnomidae 43 and Psychomyiidae 99.

After a revision of the family Limnophilidae based on material described until 1955 Schmid (1955) lists 676 species for this family.

The small families that have been established over the last decade are Xiphocentronidae — 4 species (Ross, 1949; Sturm, 1960), Philoreithoridae — 7 species, Plectrotarsidae — 3 species, Philanisidae — one species, Helicophidae — 2 species (Mosely and Kimmins, 1953), and Phryganopsychidae — 2 species (Wiggins, 1959).

The increasing volume of material for investigation plus the widening s scope of theoretical problems to be examined compelled entomologists concerned with Trichoptera to renew their studies. A remarkable series of works devoted to a revision of the family Limnophilidae was published by the Swiss entomologist Schmid (1950–1955) in the form of a rapid succession of studies giving a critical treatment of the different genera and subfamilies and a general review of the system of the family as a whole (Schmid, 1955). Instead of the formerly recognized two subfamilies, Schmid now established six: Dicosmoecinae, Apataniinae, Neophylaeinae, Pseudostenophylacinae, Drusinae, and Limnophilinae; the last subfamily was, for the first time in the history of the system, broken down into four tribes: Limnophilini, Stenophylacini, Chaetopterygini, and Chilostigmini. After a thorough critical revision and consideration of the synonymy, Schmid, as mentioned above, established 676 species.

Specialization found its expression also in restricting the study to stages of development, e. g., larvae or adults.

141 Schmid studied only adult Trichoptera. His neglect of the morphology of the early stages affected the value of his results. An example is the revision of the tribe Baicalinini Mart. (= Thamastini Schm.) and the fact that he considered the genera Baicalina Mart., Baicalodes Mart. and Baicalinella Mart. as synonyms of the genus Radema Hag.; in fact, these genera differ in the larvae in characters which are more important than species characters, e. g., structure of the head sclerites, form of the gula, chaetotactic characters, presence or absence of a horn, presence or absence of gills, and form or arrangement of the gills (Bebutova, 1941; Lepneva, in press).

Winkler (1961) wrote a detailed study of the European species of Limnophilus; his keys to the species were based on adult males and females; these keys are accompanied by drawings of the genitalia.

Hickin (1942—1958) described the larvae of all species in Great Britain; he included numerous drawings and in 1953 published a richly illustrated popular work on all stages of development.

Dohler (1950) published a large work on the genus Rhyacophila. He divided the genus Rhyacophila into several species groups which he regards as subgenera (Rhyacophila s. str., Hyperrhyacophila, Pararhyacophila, Prosrhyacophila, Metarhyacophila and Hyporhyacophila), based on the morphology of the larvae.

A study of the larvae of the species Rhyacophila outside Europe showed that the types of larvae of the genus are markedly more diverse than in Europe. This division of the genus Rhyacophila into several species groups based on the larva is very interesting; because this genus is very large, however, it seems premature to consider these groups (which are based on European material) as subgenera; we consider, therefore, that Döhler's groups are species groups.

Ross made a similar study of the genus Rhyacophila, based on adult insects. He considered the family Rhyacophilidae as consisting of 2 subfamilies, Rhyacophilinae and Hydrobiosinae; he excluded the subfamily

Glossosomatinae, which he separated as a family. Ross (1956) published a large work on the 3 families Rhyacophilidae, Glossosomatidae and Philopotamidae, which occur mainly in mountainous regions. He included in the subfamily Rhyacophilinae the genera Rhyacophila Pict. and Himalopsyche Banks.* After establishing synonyms, he left in the subfamily (until 1956) 312 species, 288 of them in Rhyacophila and 24 in Himalopsyche (Ross, 1956:116–123); he listed 159 species for Glossosomatidae (except the Protoptilinae).** Lepneva (1956) described another genus of Rhyacophilinae (based on the larva): Philocrena Lepn. with one species (Ph. trialetica Lepn., from the Caucasus).

142 Ross based his revision of the genus Rhyacophila on the morphology of the male genitalia; he divided the species of the genus in 9 branches; each branch was divided into several species groups. He described the phylogenetic relationships and origin of the branches and the species groups in a dendrogram (Ross, 1956:76, cart 16); he listed the groups of each branch and the species of which they consist on pp. 107–116.

The number of species of Rhyacophila with described larvae is much smaller than the number of species of this genus throughout the world; it is, therefore, impossible to confirm Ross's classification as regards the morphology of the larvae. However, in some groups in which the larvae of one or several species are known, it is possible to compare the relationships established on the basis of the adults with those in the larvae.

We take for comparison the following groups (Ross, 1956:116–123):† from the 1st branch of Ross, the groups "lobifera," torva" and "glaberrima"; from the 2nd branch, the group "tristis"; from branch 3, the groups "curvata" and "acropedes"; from branch 4, the groups "fuscula" and "vulgaris"; from branch 6, the groups "invaria," "glareosa," "carolina," "philopotamoides" and "scissa"; from branch 7, the group "sibirica"; from branch 9, the groups "retracta," "naviculata" and "nigrocephala"; we take the species Rh. brevicephala, Rh. shikotsuensis, Rh. impar, Rh. yamanakensis and Rh. hokkaidensis, which were not included in the 9 branches.

We shall examine the groups according to the degree of complexity of the organization of the larvae of the species, and not according to the order of Ross. We begin with species with the most primitive larvae (group Hyporhyacophila Döhler) and end with species the larvae of which show the highest level of organization (group Rhyacophila s. str. Döhler).

Branch 1 of Ross includes 8 groups distributed in the east and west of North America, South Asia and southern Europe. The larvae of the 3 North American groups "lobifera," "torva" and "glaberrima" (of the species Rh. lobifera, Rh. torva and Rh. glaberrima) belong to the most primitive type, to the group Hyporhyacophila. The larvae of Hyporhyacophila lack thoracic and abdominal gills; they have a simple, little differentiated, primary chaetotaxy and simple anal legs which are without a distal, sword-shaped process of sclerite "b"; according to the form of the body, the foregoing characters and other characters the larvae of the group Hyporhyacophila closely resemble the 1st-stage larva (the

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* The species fletcheri Kimm., which was separated by Kimmins as the genus Trichophila, was placed by Ross in a group of the genus Rhyacophila.

** In the first volume of the "Trichopterorum Catalogus" Fischer listed 218 species for the Rhyacophilinae (until 1938), with 31 for the Hydrobiosinae and 113 for the Glossosomatinae (Glossosomatidae of Ross) (Fischer, 1960:12–163).

† The names of the groups of the genus Rhyacophila in Ross's scheme are listed in quotation marks.

1st-stage larva is very similar in the different species); the larva of the Hyporhyacophila type resembles this primitive stage but is larger.

Branch 2 consists of 2 American groups with species, the larvae of which are not known, and the European group "tristis," the species of which (Rh. tristis and Rh. aquitanica) belong to the primitive type of the group Hyporhyacophila like the species of branch 1.

Branch 3 consists of 3 groups distributed in South Asia, Japan and North America; only the larvae of the group "acropedes" are known, of the 143 North American species Rh. acropedes and of the Japanese species Rh. articulata.* The larva of Th. acropedes and that of the Japanese-Sakhalin species Rh. hokkaidensis, not included in the groups of Ross, form the group Paleorhyacophila Lepn., described below; the larvae of Rh. articulata belong to the type of the group Hyporhyacophila.

Branch 6 consists of 9 groups, 3 of which are distributed in North America, 3 in Asia, 1 in North America and Europe and 2 in Europe. The larvae of the following North American groups are known: "carolina" (Rh. fenestra, Rh. ledra, Rh. kiamichi) and "invaria" (Rh. invaria, Rh. vibox, Rh. nigrita), and also of those of the middle- and South Asian group "scissa" (Rh. obscura) and of the European groups: "philopotamoides" (Rh. hirticornis, Rh. philopotamoides and Rh. pubescens) and "glareosa" (Rh. glareosa);** the larvae of the preceding species belong to the primitive type of the group Hyporhyacophila Döhler. The larvae considered as the type of the group Hyporhyacophila differ also in other characters, such as form of head and mandibles, and shape and length ratio of legs; they thus are subgroups of the group Hyporhyacophila. The larvae of Rhyacophila obscura of the group "scissa" (branch 6) have a flattened head and strong forelegs which are longer than the thin mid- and hind legs; similar forelegs are characteristic for the larvae of the American species Rh. fenestra of the group "carolina" and for the larva of Rhyacophila sp. A (javana?), described by Ulmer (1957:140—141, Plate 12, Figures 34—35).

Branch 7 includes the small Japanese-Chinese group "yosiiana" and the large group "sibirica" with 26 species and 3 European species (Rh. abchasica, Rh. laevis, Rh. producta), which are distributed in North America, Japan, the Ussuri territory and Siberia. Larvae of 4 American species in the group "sibirica" are known; Rh. atrata and Rh. melita belong to the group Mesorhyacophila Lepn. (see p. 248) according to the larvae; Rh. minora and Rh. manistee belong to group Hyporhyacophila; to the same primitive group apparently belong the larvae of the Asian species Rh. narvae and Rh. sibirica, and probably also Rh. depresse and Rh. lenae; of the European species of the group "sibirica" the larvae of Rh. abchasica belong to the group Hyporhyacophila (see footnote on p. 136).

The European species Rh. laevis has an isolated position in the group; the larvae of this species have single abdominal gills. On the basis of this and other characters, Döhler separated this species as the group Prosrhyacophila (this species was included in the group "sibirica" of Ross). One may also place Rh. retracta of branch 9 in the group Prosrhyacophila; the larvae of this species also have finger-shaped gills; however, they are smaller than those of Rh. laevis and have a slightly different structure.

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* Rh. articulata Morton (syn. Rh. towadensis Iwata); see Ross, 1956:117; Fischer, 1960:73.

** See: Döhler, 1950:250, 273, 289; Lepneva, 1961:652.

The large branch 9 consists of 10 groups distributed in eastern Asia, partly in southern Asia, and in North America; there are no European species in branch 9. The larvae of the species of branch 9 are little known; only the larvae of some species of 3 groups of the branch are known. In the group "nigrocephala," the larvae of the Ussuri species Rh. lata and 144 probably also Rh. manuleata and of the Japanese species Rh. nigrocephala belong to the group Hyporhyacophila; the larvae of Rh. retracta may be placed in group Prosrhyacophila and the larvae of Rh. lieftincki in the group Mesorhyacophila Lepn.

In addition to Rh. brevicephala and Rh. shikotsuensis, the larvae of which belong to the group Hyporhyacophila, and the 49 species of Rhyacophila not included in the 9 branches, there are also 3 species which, according to the larvae, do not belong to Döhler's groups (which were based on European material); these are Rh. impar and Rh. yamanakensis, the larvae of which have a sword-shaped process of the anal legs, but which either lack thoracic and abdominal gills (Rh. impar) or lack abdominal gills but have single thoracic gills (Rh. yamanakensis); as an addition to Döhler's scheme, the author separates these species as the group Mesorhyacophila Lepn. (see p. 236 and Lepneva, 1963:62—63); to the same group belongs the species Rh. lieftincki of the group "naviculata" from Java (branch 9); the larva of this species was described by Ulmer (1957:138—139, Plate 11, Figures 22—26); like the larva of Rh. yamanakensis, it has only thoracic finger-shaped gills and a sword-shaped process of the anal legs similar to that of the larvae of Rh. impar; to the group Mesorhyacophila belong the American species Rh. fuscula (group "fuscula" of branch 4), Rh. atrata and Rh. melita of group "sibirica" (branch 7); the larvae of this species have no gills but have a sword-shaped process of sclerite "b" of the anal legs; this process has a slightly irregular form. Recent descriptions and drawings of larvae of the American species placed by us in the groups Hyporhyacophila, Mesorhyacophila and Paleorhyacophila were given by Flint (1962).

The larvae of Rh. hokkaidensis (not included by Ross in the groups) and of Rh. acropedes of branch 3 were separated as the group Paleorhyacophila Lepn. (Lepneva, 1963:68); these larvae resemble on the whole the type Hyporhyacophila; they have a simple sclerite "b" of the anal legs without a sword-shaped process; however, like the higher species of Rhyacophila, they have branched pleural and dorsal abdominal gills.

Mesorhyacophila and Paleorhyacophila are intermediate between species with primitive larvae of the type Hyporhyacophila and Prosrhyacophila and the species of higher groups of the genus, which have complex gills and anal legs with a large sword-shaped process (group "vulgaris" of branch 4).

Branch 4 consists of 2 small North American groups, including the group "fuscula," which includes Rh. fuscula placed in the group Mesorhyacophila; branch 4 also contains the large group "vulgaris" (45 species), which consists of only European and Caucasian species. The group "vulgaris" contains species the larvae of which have similar complex anal legs with a large sword-shaped lateral process of sclerite "b" and different, complex thoracic and abdominal gills. Döhler distributes these larvae in several groups. To the group Pararhyacophila Döhler (the larvae of which have abdominal gills which form a tuft of 4 short finger-shaped filaments) belong Rh. intermedia (Central Europe), Rh. forcipulata (Caucasus) and Rh. bacurianica (Caucasus, Lepneva, 1961:655—656);

145 to the group Hyperrhyacophila Döhler (the larvae of which have abdominal gills which form a conical style with longitudinally arranged filaments) belong Rh. torrentium (Europe) and Rh. vicaria (Caucasus); Döhler (1950:276) placed Rh. albardana (Europe) in the same group. To the group Rhyacophila s. str. belong numerous species, the larvae of which have gills which form a tuft of filaments on the apex of a short style; these include the European species Rh. vulgaris, Rh. dorsalis, Rh. obliterata, Rh. septentrionis, Rh. hageni, Rh. nubila, Rh. fasciata, Rh. aurata; they include the Caucasian species Rh. subnubila, Rh. subovata and Rh. cupressorum.

In spite of the few data on the larvae of Rhyacophila there is a connection between the distribution of the groups and the characters of the larvae.

It follows from the foregoing data that most of the groups of Ross's species have conservative larvae* in which they change little through all 5 larval stages; the full-grown 5th-stage larva of these species closely resembles the 1st-stage larva, and belongs to the primitive type Hyporhyacophila.

The distribution of the groups with larvae of the Hyporhyacophila type is wide, almost as wide as the distribution of the whole genus Rhyacophila. According to Martynov (1924a: 357–373), the genesis, original habitats and center of distribution of the genus Rhyacophila (as that of many other groups of Trichoptera in the northern zone) were in Angara; Angara was connected with North America by the Bering Bridge, and its western part was for a long time separated from Europe by an arm of the Turgai Strait.**

Most of the recent Asian and American species of Rhyacophila have larvae of the primitive type Hyporhyacophila; this type should be considered the ancient type of larvae of the Rhyacophila (closely related to the primordial type), and is most widely represented in the recent fauna in the Asian-American group "sibirica,"† and in other American, Asian and smaller American-Asian groups of Ross. The larvae of the Mesorhyacophila type are closely related to the primitive type but have more complex anal legs; they sometimes also have thoracic gills and are present in 3 species from central Asia, southern Siberia, the Ussuri territory, Japan and in 4 North American species. Single species with a larva of the Paleorhyacophila type (closely related to Hyporhyacophila but with tufted abdominal gills) are known from Japan and Sakhalin (Rh. hokkaidensis) and from North America (Rh. acropedes). Species with larvae of a higher type, i. e., of the Pararhyacophila, Hyperrhyacophila and Rhyacophila s. str. type of the group "vulgaris," are absent in America and Asia.

The European species of Rhyacophila were considered by Martynov (ibid.) as descendents of the ancient immigrants from Asia which entered Europe from Asia by the southern route of immigration after the formation
146 of the Turgai Strait and the northward regression of the sea. These ancient immigrants from Asia and Europe became isolated in Europe in later geological periods by the development of the deserts in Central Asia and the repeated transgressions of the Caspian Sea; they developed independently in Europe. A remarkable feature of this evolution is the early differentiation of a very progressive branch which resulted in the appearance in the recent

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* This can be judged by the species of some groups, the larvae of which are known.

** Following Borisyak, Martynov (1924a:732) called this boundary the Ural "Sea."

† Ross (1956) wrongly considers the Caucasian species Rh. abchasica as a Siberian species (Martynov, 1934:61).

fauna of Europe and the Caucasus of species with highly specialized larvae of the groups Pararhyacophila, Hyperrhyacophila and Rhyacophila s. str. These larvae have a flattened body, a highly differentiated primary chaetotaxy, highly, but diversely developed thoracic and abdominal gills and complex anal legs with hooklike and sword-shaped processes.

The small European species groups proposed by Ross ("tristis," "philopotamoides" and probably "glareosa"), which consist of 1 to 3 species, have larvae of the primitive type Hyporhyacophila; they were combined by Ross with the large American and Asian species groups; they represent in Europe conservative groups of descendents of the ancient immigrants from Asia; but although they remained isolated in Europe, they retained a primitive type of larva like their Asian ancestors; according to Ross, they also retained their common systematic position in branches 2 and 6 (which include large Asian-American and small European groups).

A similar position in branch 1, which contains several Asian-American groups and 1 European group, is taken by the group "stigmatica" (Rh. stigmatica, Rh. meyeri, Rh. bonaparti); the larvae of this group are of the Metarhyacophila type* which is closely related to the primitive type Hyporhyacophila; however, it has fringed abdominal gills and is convergent to the Asian larval type Paleorhyacophila.

Thus, the classification of the Rhyacophila established by Ross on the basis of imaginal characters proves on the whole correct (with several exceptions) also as regards the relationships in the larvae (which are not completely clarified). This classification thus is close to a natural system of the Rhyacophila, reflecting its phylogeny and evolution.

Flint and Wiggins revised some American groups (both adults and larvae). Flint published articles on the larvae of the Nearctic species of the genera Limnophilus and Arctopsyche; he also described the American species of Rhyacophila which are used in the present book (Flint, 1960, 1961, 1962). Wiggins wrote a survey of the Nearctic species of Beraea, established a new family (Phryganopsychidae) and described the larvae of the American species of Phryganeidae (Wiggins, 1954, 1959, 1960); he also established the subfamily Yphrinae in the Phryganeidae; this subfamily consists of a single, primitive species, Yphria californica Banks (Wiggins, 1962).**

The trend of work of Siltala was raised to a high level by Nielsen† (see
147 bibliography on pp. 176, 193, 194).

Nielsen began a study of oviposition, egg masses and the 1st-stage larva of 1 species in connection with his hydrobiological studies (Nielsen, 1936:255–266); Nielsen appreciated exact comparative morphological data for the solution of biological problems and for the clarification of the phylogeny of Trichoptera; he wrote as follows: "Ist doch die Morphologie die Lehre vom Werkzeug, die Biologie die Lehre von seiner Anwendung! Ferner wird eine solche Untersuchung zum Verständnis der ganz unklaren Frage der Phylogenie der Ordnung beitragen können und somit auf den entwicklungsgeschichtlichen Zusammenhang der verschiedenen biologischen Typen Licht werfen" (Nielsen, 1942:257).

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* The larvae are described according to Döhler (1950); the author did not see larvae of the Metarhyacophila type.

** All the other genera of Phryganeidae belong to the subfamily Phryganeinae.

† Snodgrass, 1935.

Nielsen did not deal with the phylogeny of the order as a whole, because he thought that the morphological material available was inadequate. He used his data for the clarification of problems of phylogeny of certain groups and their systematic position. However, he restricted himself to the morphology and biology of the early stages of development. Hence, Nielsen's methods were the exact opposite of those of Schmid (an interesting phenomenon of specialization!).

Entomologists have been of the opinion for a long time that the family Rhyacophilidae is primitive; Nielsen confirmed this by the following characters of the full-grown larvae (Nielsen, 1942:178—179); 1) the head capsule of some species of Rhyacophila resembles that of Rhaphidiidae; 2) there is a simple articulation between the pleural sclerite and the coxa; 3) the arrangement of the gills is primitive; 4) the anal legs (like those of Hydroptilidae) are intermediate between the long legs of Philopotamidae and Polycentropodidae and the short legs of Integripalpia.

Nielsen wrote a large work on the morphology and biology of the larvae and pupae of Hydroptilidae (Nielsen, 1948); according to the larvae, he found that this family (which had been considered as homogeneous) consists of 2 different complexes. On the basis of a small amount of European material, he separated these complexes as 2 new subfamilies: Hydroptilinae (genera Hydroptila, Agraylea and Oxyethira) and Orthotrichinae (genera Orthotrichia and Ithytrichia). We consider these subfamilies as groups of genera. The family Hydroptilidae is closely related to the Rhyacophilidae in some characters, according to Nielsen; according to other characters to the Glossosomatidae.

In his "Trichopterologische Notizen" (Nielsen, 1943—1944), which deals with the phylogeny of a number of groups, Nielsen revised the classification of the Limnophilidae; he separated the new subfamily Ecclisopteryginae on the basis of the morphology of the larvae and pupae (Nielsen, 1943); it consists of the genera Ecclisopteryx and Drusus. The validity of the subfamily is supported by the following characters: 1) the characteristic form of the head (which differs from that of Limnophilinae) with a dorsal
148 ridge and secondary setae; 2) the mandibles (like those of Apatania and unlike those of Limnophilinae) are without denticles, have a sharp line along the distal margin and are adapted for scraping; 3) the pronotum has a characteristic form, with a transverse carina; 4) the chaetotaxy of the legs is characteristic; there are numerous secondary setae on the femora, and the claw bears a long basal seta like the Apataniinae; 5) there are dorsolateral processes on the 8th abdominal segment; 6) head and mandibles of the pupa have a characteristic form; 7) the female lays eggs under water as Apatania.

Nielsen considers the subfamily Ecclisopteryginae as related to the Apataniinae.

In his recent work on the family Limnophilidae, Schmid accepts the subfamily of Nielsen, and places 9 genera in it; he wrote a monograph on this group ("La sous-famille des Drusinae"); larvae of this subfamily are known for the genera Drusus and Ecclisopteryx (Schmid, 1956). Contrary to the rules of nomenclature, Schmid renamed the subfamily after its largest and most ancient genus (Drusus), which contains 33 species of the 42 species of the whole subfamily; in his phylogenetic scheme, Schmid shows the predominant position of the large genus Drusus among the other small genera. The authors differ about the phylogenetic relationships of the Drusinae and on its position in the Limnophilidae. Schmid is of the opinion that it is unlikely that the adults of Drusinae are closely related to the Apataniinae; he considers the Drusinae as highly specialized and places them next to the Limnophilinae (after the Neophylacinae and Pseudostenophylacinae); he assumes that the close relationship of the Drusinae to the primitive subfamilies Dicosmoecinae and Apataniinae persists in the early stages of development, but disappears in the adults (Schmid, 1956:6). We should like to state that a number of morphological larval characters, such as the presence of a dorsal ridge on the head, the form of the pronotum, the rich secondary chaetotaxy on coxae and femora, the dorsolateral processes on the 8th abdominal segment, and the characteristic form of head and mandibles of the pupa show characters which also prove that the subfamily is a specialized group. It seems more correct to consider the resemblance of the mandibles of Ecclisopteryx and Apatania and the form of the seta of the claw of these larvae as convergents caused by similar conditions in cool running water and by feeding on microflora on stones.

Nielsen confirms the view which had been repeatedly expressed before, that the family Sericostomatidae is collective and artificial. He does not recognize this family and places its subfamilies in his classification according to the characters of the larvae. He places the subfamily Goerinae in the Limnophilidae and the Sericostomatinae in the Beraeidae. Schmid (1955:14)* did not accept this classification.

It follows from the foregoing that neither a morphological analysis of the larvae and pupae nor the revision of the types on which the classification
149 of adult Trichoptera is based resulted in agreement. On the contrary, differences of opinion became sharper. These differences do not result from different interpretations, but are based on contradictory data obtained in various fields. This suggests that numerous unsolved problems remain in the classification of the group.

Nielsen showed that the classification of Trichoptera is based on the genitalia of the adults, although the views on the morphology of the genitalia are not always accurate. According to him, even the recent work of Schmid is not free of this disadvantage. Nielsen made detailed comparative morphological studies of the male genitalia and published a large monograph on this subject (Nielsen, 1957).

Nielsen's publications had a great influence on the descriptions of the larvae of Trichoptera.

The Rumanian entomologists Murgoçi and Botoşăneanu made extensive studies on the larvae and adults of Trichoptera of Rumania, Poland and Bulgaria; Botoşăneanu (1959, etc.) also published several works on the ecology of Trichoptera.

We should like to discuss the influence of the publications in the 1940's and 1950's on the classification of Trichoptera.

Since the 1930's, the classification of Trichoptera was revised along 3 lines: 1) the creation of new families because new species were described which could not be included in the old families; 2) the enlargement of the families of the classification of Ulmer-Martynov; 3) the division of families. The number of families increased from 16 in 1924–1934 to 30;** the number of species came close to 5,000 (Ross, 1956:1, 6).

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* We consider the Goeridae and Sericostomatidae as families.

** Annulipalpia — 11 families, Integripalpia — 19 families.

Ross (1949) established a small new family of Annulipalpia with 3 species of the genus Xiphocentron Brauer, 1870 (which was placed before in the Hydropsychidae (Ulmer, Genera Insectorum, 1907:176, Figure 217)) and 1 species from south China (X. hwangi Ross). He described later X. sturmi Ross from the tropical forests of Colombia; this species has an interesting larva and pupa and is terrestrial (cf. Sturm, 1960). Ross stressed its close relationship "to the ancestral stock of the Psychomyiidae" (Ross, 1949:2).

The larva of X. mexico (the close relationship of which to the Psychomyiidae is even more marked than in the adult) was recently found in the sources of a cold, slowly running brook in Texas; this close relationship is expressed in such characteristic structures as a labium without palps, elongated into a narrow spinning organ, a trochantin with a large distal lobe, anal legs with claws bent at a right angle and the pupal mandibles elongated into thin filiform distal endings. Edwards (1961), who described the larva, placed it in the Psychomyiidae together with Lype
150 and Tinodes; Flint was of the same opinion. However, this opinion is contradicted by the important fact that this species has no mental sclerite, its frontoclypeal sclerite has no lateral notch and the claws of the anal legs have no ventral spinules. The larva builds galleries at the bottom of a source which are about 5 cm long and differ from those of Psychomyiidae in that part of them is situated below the water, the other part above water, among the crusts on stones of the littoral. The characteristics of the preimaginal stages of X. mexico thus do not invalidate the status of the family Xiphocentronidae. The larvae of X. sturmi build similar structures but outside the water in humid forests (relative humidity of 90—90.9%), among slimy deposits on horizontal branches. The full-grown larvae of X. sturmi have not been described, but the pupal structures of this species are quite characteristic, spindle-shaped with double walls* hanging from a thin, hollow style (Sturm, 1960).

The differences in the descriptions of the larvae and pupae of Xiphocentron show that this small and very ancient genus is complex; possibly, it should be divided into subgenera according to the morphology of the preimaginal stages, their structures and their geographical distribution, as stated by Ross (Ross, 1949:51).

Ross (1938:135—136; 1944:51—52, Figures 189—201) enlarged taxonomic units.** He united the Psychomyiidae and Polycentropodidae at first as Polycentropodidae and later as Psychomyiidae, disregarding the marked difference between the larvae of these families, which had already been noticed by Siltala (1907:600—601). Objections to the unification of the foregoing families were made by Mosely (1945:1946), Ulmer (1951:109—110) and Lepneva (1956:10—15) on the basis of the morphology of the larvae. Some American authors accepted the views of Ross.

Ross and other authors recently considered the former subfamily Glossosomatinae as the family Glossosomatidae; we accept this view.

Ulmer, in his work on the Sunda Islands, described the subfamily Ecnominae of the family Psychomyiidae as follows: "Vielleicht müssen die Ecnominae einmal als besondere Familie betrachtet werden" (Ulmer, 1951:146).

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* Apparently representing cocoon and case.

** See section 5 and the following genera of section 4 of McLachlan (1874—1880:392).

As some characters of the larvae of Ecnomus distinguish this genus
from other genera of Psychomyiinae and Polycentropodinae more sharply
than the adults, Lepneva proposed to raise the subfamily Ecnominae Ulm. to
the rank of family (Lepneva, 1956:16–26, Figures 1–42). The same was
later proposed independently by Marlier (1958:314). Lepneva (ibid.)
described the following family characters of the larvae of Ecnomidae, which
distinguish it from the Psychomyiidae and Polycentropodidae: 1) the
chaetotaxy of the frontoclypeus; 2) the form and chaetotaxy of the labrum;
3) the characteristic form of the mandibles, which are without a penicillus;
4) the characteristic form of the mental sclerite; 5) the characteristic form
of the eulabium, with its relatively large palps; 6) the presence of
characteristic, strongly reduced, spoon-shaped setae on the propleuron;
7) the sclerotized meso- and metanotum; 8) the chaetotaxy of the legs;
9) the form and chaetotaxy of the anal legs with the characteristic claw,
151 with a ventral comb of spinules. The subfamily diagnosis of the adults
is considered as the family diagnosis.

According to the degree of development of the chaetotaxy of the full-grown larva (it may be nearly absent, little developed, or richly developed) Lepneva divided the suborder Annulipalpia into the 2 superfamilies, Paleochaetoidea and Neochaetoidea (1956:14, 19). The Paleochaetoidea include the lower families of the suborder from the most primitive families: Rhyacophilidae, Glossosomatidae, Hydroptilidae, Philopotamidae, Xiphocentronidae and Psychomyiidae; the Neochaetoidea include the higher families with a relatively rich or richly developed secondary chaetotaxy: Ecnomidae, Polycentropodidae, Arctopsychidae and Hydropsychidae.

After the aforementioned changes, the classification of the Annulipalpia is as follows:

I. Annulipalpia Mart.

A. Paleochaetoidea Lepn.

1. Rhyacophilidae Steph.
2. Glossosomatidae Wall.
3. Hydroptilidae Steph.
4. Philopotamidae Steph.
5. Xiphocentronidae Ross.
6. Stenopsychidae Mart.
7. Psychomyiidae Kol.

B. Neochaetoidea Lepn.

8. Ecnomidae Ulm.
9. Polycentropodidae Ulm.
10. Arctopsychidae Mart.
11. Hydropsychidae Curt.

The classification of the Integripalpia has also been changed recently.

Wiggins (1959) described the larvae of Phryganopsyche latipennis Banks, and separated from the Phryganeidae the small family Phryganopsychidae, which consists of only 2 species, Ph. latipennis Banks, 1906 and Ph. cornuta Kimmins, 1950. The adults of this new family do not differ so sharply from the Phryganeidae as the larvae, in which the independence of the family is clearly marked by a number of characters, e. g., form of head and frontoclypeus; uniform light brown color of head and pronotum; presence of a faintly marked submental sclerite; characteristic form of galea and maxillary palps; slightly elongate eulabium, with its large palps; completely sclerotized mesonotum and the absence of a dorsal tubercle on the 1st abdominal segment. The larval case of Phryganopsyche latipennis is not built of fresh plant fragments but of minute detritus particles arranged irregularly on the tube; this resembles some parts of the tubes of Psychomyiidae or the dwelling chamber of some Polycentropodidae covered with detritus. The larval case is straight and broad as in Phryganea and has open anterior and posterior ends (Wiggins, 1959:745—757, Figures 1—2). The family Phryganopsychidae is the most primitive family of the suborder.

Tsuda (1936) established the family Kitagamiidae from Japan. Ulmer (1951) renamed this family Limnocentropodidae. The family was again given its original name according to paragraph 54 of the "Copenhagen Resolutions on Zoological Nomenclature" (Wiggins, 1956:1).

In their studies on the Trichoptera of Australia and New Zealand, Mosely
152 and Kimmins (1953) added the family Philorheitridae with 7 species
(previously considered as an endemic family) and the 3 following new
families of Integripalpia: Plectrotarsidae Mos. et Kimm. (3 species),
Philanisidae Mos. et Kimm. (1 species), Helicophidae Mos. et Kimm.
(2 species). The larva of Philanisus plebeius McL., living on the
coast of the ocean, was described by Ulmer (1953); the larvae of the other
families are not known.

Ross (1938:135—139; 1944:51—76) and other authors, including Schmid (1955:14), stated repeatedly that the family Sericostomatidae is artificial. They replaced it with 5 families which are the former subfamilies of Sericostomatidae raised to the rank of family: Goeridae Ulm., Lepidostomatidae Ulm., Brachycentridae Ulm., Sericostomatidae Steph., Helicopsychidae Ulm.; the family Thremmatidae Mart. should be added.

The addition of the small new families did not much change the general appearance of the order because of the small size of the relict families in the Tropics and Subtropics. Such rarities will probably also be found in future in little studied countries; however, the classification of the greater part of the order into families was already established at the beginning of this century; it was made more accurate by detailed studies of the morphology of the group, especially of the larvae.

A list of the families of the new classification of Trichoptera Integripalpia created by the above authors until 1960 is given below.*

II. Integripalpia Mart.

1. Phryganopsychidae Wigg.
2. Phryganeidae Burm.
3. Kitagamiidae Tsuda
4. Plectrotarsidae Mos. a.Kimm.
5. Limnophilidae Kol.
6. Goeridae Ulm.
7. Lepidostomatidae Ulm.
8. Brachycentridae Ulm.
9. Philorheitridae Mos.
10. Philanisidae Mos. a. Kimm.
11. Helicophidae Mos. a. Kimm.
12. Calamoceratidae Ulm.
13. Odontoceridae Wall.
14. Molannidae Wall.
15. Leptoceridae Leach.
16. Beraeidae Wall.
17. Sericostomatidae Steph.
18. Helicopsychidae Ulm.
19. Thremmatidae Mart.

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* Ulmer (1957) lists 28 families, i.e., all the foregoing except the families Phryganopsychidae and Thremmatidae, which were not established at that time; the family Thremmatidae was considered by Ulmer as the subfamily Thremmatinae of the family Brachycentridae.

The following families of Trichoptera have been recorded from the USSR:

Annulipalpia Mart.

Paleochaetoidea Lepn.

1. Rhyacophilidae Steph.
2. Glossosomatidae Wall.
3. Hydroptilidae Steph.
4. Philopotamidae Steph.
5. Stenopsychidae Mart.
6. Psychomyiidae Kol.

Neochaetoidea Lepn.

7. Ecnomidae Ulm.
8. Polycentropodidae Ulm.
9. Arctopsychidae Mart.
10. Hydropsychidae Curt.

Integripalpia Mart.

1. Phryganeidae Burm.
2. Limnophilidae Kol.
3. Goeridae Ulm.
4. Lepidostomatidae Ulm.
5. Brachycentridae Ulm.
6. Calamoceratidae Ulm.
7. Odontoceridae Wall.
8. Molannidae Wall.
9. Leptoceridae Leach.
10. Beraeidae Wall.
11. Sericostomatidae Steph.
12. Thremmatidae Mart.

153 The fauna of the Palearctic Region is more widely represented in the Trichoptera of the USSR than in other countries of Eurasia; it is represented by Holarctic and Transpalearctic forms and forms with a narrow distribution, e. g., Ussuri, Siberian and European species together with species of the Mediterranean, Indian and Japano-Chinese subregions, which occur at the borders of the USSR.

The incomplete faunistic composition of Trichoptera in the USSR compared with the world fauna is shown not so much by the absence of the small tropical families as by the fact that the large subtropical and tropical families and subfamilies are represented in the USSR only by a few species, e. g., Hydrobiosinae are represented by 2 species; Macronematinae by 3 species; Calamoceratidae by 2 species; Odontoceridae by 2 species.

The larvae of all families and most of the subfamilies in the USSR are known; all or almost all the larvae of some small groups are known, but not all larvae of large groups are known, sometimes only the larvae of a few species of the group.

## Phylogeny

We have discussed the phylogenetic relationships of families in the preceding chapter as far as possible in connection with the morphology and biology of the larvae. In the present chapter, we attempt to use these data to establish a temporary phylogenetic scheme of the order.

Neither McLachlan nor other authors discussed the phylogeny of the order as a whole; none of them made a phylogenetic scheme of the order. The only exception is the phylogenetic scheme of Ulmer (1912b:377) which establishes remote phylogenetic relationships. Martynov discussed the phylogenetic relationships and phylogeny of a number of groups (Martynov, 1924b:209—224); however, as regards the phylogeny of the whole order, he published only the diagram on Plate 1, which is a supplement to his phylogeny of insect orders (Martynov, 1938: Plate 1). Martynov places the time at which the suborders of Trichoptera diverged in the Paleozoic; he considers each suborder as an individual stem with parallel development.

The data on the morphology and biology of Trichoptera which had accumulated to the end of the 1930's enabled M. Milne and L. Milne (1939) to put forward a hypothesis on the phylogeny of the families of the order; they represented this hypothesis in form of a 3-dimensional diagram (ibid., p. 540). The depth of this diagram represents the environment; the oblique plane separates the smaller part (rapidly flowing water) from the larger part (slowly flowing or stagnant waters).

Following the data of Siltala on the primitiveness and specialization of the larvae, Milne considers as ancestors of the order insects with a simple larva resembling the larva of the recent Psychomyiidae, which live in tubular tunnels at the bottom of slowly flowing streams. According to Milne, the later evolution followed 2 courses which led to the development of the families of Annulipalpia on the one hand, and on the other to those of the Integripalpia. The development of the first group was connected with a change to life in rapidly flowing streams; the development of the second group was connected with a change to life in stagnant water and with an
154 extension of the ecological range to life in slowly flowing water. The change of some forms to biotopes in rapidly flowing streams was connected with abandonment of the tubes and a change to a free mode of life (like the recent Rhyacophilidae). In other forms, this was connected with a shortening of the tubes and a transformation of the anterior end into a capturing net (as in the recent Polycentropodidae and Hydropsychidae); some of the recent Annulipalpia have retained their ancient mode of life in slowly flowing waters (the recent Psychomyiidae, according to Milne).

According to Milne, the evolution of the second group, which resulted in the development of the recent Integripalpia, took place on the side of the "plane" of Milne's diagram which represents slowly flowing and stagnant water. The first group developed into the complex Leptoceridae-Odontoceridae-Molannidae-Baraeidae, which is situated most closely to the oblique "plane" of the diagram; the peak of the branches or the large branches of the foregoing group "penetrated through the plane" at the highest stage of their evolution and became adapted to conditions which were alien to their ancient nature: they shifted to rapidly flowing waters. The complex of subfamilies of the family Sericostomatidae is isolated as an artificial group which was established with a great amount of "stretching"; in its last stage of development, this group diverged widely and the peak of its branches partly penetrated beyond the "plane" into rapid waters. In an isolated position at the extreme left of the diagram are situated the limnophilic family Phryganeidae and the Limnophilidae, which are considered as a limnophilic family. Milne's diagram is interesting systematically and ecologically; the groups are arranged in sequence from the left to the right, gradually moving away from life in stagnant waters (limnophilid-phryganeid complex) toward life in rapidly flowing water (rhyacophilid complex); at the left, stand the higher Integripalpia (Limnophilidae-Sericostomatidae) and on the right, the lower Annulipalpia.

The ecological and biological data which have accumulated clearly show the error of the authors of this diagram, which is based on the ecology of the larvae; they placed the whole large, ancient suborder Annulipalpia in the small upper part of their diagram. In fact, however, flowing waters with their widely varying speed of current are the environment in which the main part of Trichoptera became differentiated and in which it reached its recent level of development.*

On the other hand, stagnant water was a relatively little inhabited environment in the history of the order; it was inhabited by only isolated families (Phryganeidae) and some branches of a few large families (usually small families such as the limnophilic Polycentropodidae and Leptoceridae). The tribe Limnophilini of the large subfamily Limnophilinae was the only large group represented in this environment.**

Milne does not discuss the morphology of the larvae except in a general way when he divides the order into Martynov's suborders; he mentions only the presence or absence of ocelli in adults in the scheme based on the
155 larvae ecology. Of biological problems, he mentions in a general way only the mode of feeding; he says that the Annulipalpia are predators and that the Integripalpia are phytophagous or scavengers. He does not mention the high differentiation of the mode of feeding of the Annulipalpia.

Ross (1956:10) made a phylogenetic scheme of the order which was based on the full-grown larvae.

The morphological characters of the larvae of Rhyacophilidae, Glossosomatidae and Hydroptilidae (especially details which relate these groups with Integripalpia) gave Ross convincing and weighty arguments to place this primitive and genetically uniform group of families in the center of his phylogenetic scheme. This group is intermediate in the larvae between the other more specialized Annulipalpia and the Integripalpia. Ross made this scheme biologically complex and included the characters of the larvae, pupae and adults. He considered the following as primitive characters of the stages of development: in the larva — 1) antennae short, situated at base of the mandibles; 2) trochantin free, separated from episternum by a narrow membranous stripe; 3) pronotum sclerotized; mesonotum and metanotum membranous; 4) anal legs long, with a claw articulated to the sclerite by a bridge; in the pupa — absence of anal lobes; in the adult — 1) presence of ocelli; 2) males and females have 5-segmented maxillary palps and 3-segmented labial palps; 3) ventral appendages of the male genitalia are 2-segmented.

Ross based his phylogenetic constructions on ancestral forms of a different degree of antiquity. The primary divergence of the most ancient ancestor of Trichoptera developed into 2 ancestral forms, "A" and "B"; "A" developed into the group living in immovably attached shelters with a soft dorsum of abdominal segment 9 and with a divided last segment of the maxillary palps of the adults;† "B" developed into free-living larvae with a dorsal sclerite of abdominal segment 9 and an undivided last segment of the maxillary palps. The first group includes all the recent Annulipalpia†† without the 3 lowest families; the second group includes the 3 lowest families of Annulipalpia and the much more recent branch, all Integripalpia.

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* This is well expressed in the Russian name of Trichoptera which describes the environment; the English and German names (case-flies; Köcherfliegen) describe the fact that these insects are case-bearers, or, in other words, apply only to Integripalpia.

** All the other 5 subfamilies of the family and the 3 tribes of Limnophilinae are rheophilic.

† McLachlan's concept of Hydropsyche and the recent Annulipalpia.

†† Ross (1956:10, chapter 1) does not use the division of Trichoptera into suborders; however, the whole left part of his diagram represents all Annulipalpia (Hydroptilidae to Psychomyiidae), the right part represents all Integripalpia.

Ross constructed the diagram of the further evolution of the Annulipalpia originating from the ancestral form "A" on the basis of pupal and imaginal characters (presence or absence of anal appendages of the pupa, ocelli in the adults, presence or absence of ventral appendages of the male genitalia, etc.). He paid more attention to the larvae as he described the characters of a certain group and its position in the system.

In contrast to other authors, Ross considers the family Hydropsychidae as relatively primitive and places it between the Philopotamidae and Stenopsychidae. He considers as primitive characters the retention of a free trochantin in the larva and the presence of 2-segmented ventral appendages in the genitalia of males; however, he stresses the following, highly specialized characters of this family: loss of ocelli in adults and presence of tufted gills and the characteristic tuft of long setae on the anal legs (which is absent in other groups) in the larvae. Ross also considers
156 the sclerotization of the meso- and metanotum of the larvae as characters of specialization.

Ross considers his family Psychomyiidae (Psychomyiidae Kol. + Polycentropodidae Ulmer), united because of the loss of ocelli in adults and the 1-segmented ventral appendages of the male genitalia, as the most specialized group of Annulipalpia; he thus disregards the differences in the morphology and biology of the larvae of his combined family (Ross, 1944:51–76; 1956:10; Lepneva, 1956:10–15, Figures 1–42). These differences are very marked, however; the larvae of Psychomyiidae (Psychomyiinae of Ross) are primitive microphagous forms, with a predominance of the primary chaetotaxy, which build simple tubular tunnels resembling those assumed to have existed in the ancestral form "A"; the larvae of Polycentropodidae (Polycentropodinae of Ross) are highly specialized forms with a rich secondary chaetotaxy; they are predators which build capturing nets.

Ross thinks that the most ancient form which developed into the 3 lowest families of Annulipalpia and all Integripalpia is the ancestral form "B"; this form had an undivided last segment of the maxillary palps of the adult and its larvae were free-living, with a dorsal sclerite on abdominal segment 9. The immediate progeny of this most ancient form which became part of the recent fauna are the recent Rhyacophilidae, the larvae of which are free-living and have no portable case. The evolution of the case-bearing habit began with the appearance of ancestral form "C," the larvae of which bore a shieldlike* case and had long anal legs (represented by The Glossosomatidae in the recent fauna). The larvae of the more recent ancestral form "D" are thought to have had short anal legs and to have built sacciform portable cases of various shapes; this form is assumed to have developed into the ancestors of the recent Hydroptilidae.

In contrast to Martynov, Ross places the later development of the case-bearing habit (appearance of forms with tube-bearing larvae) in a recent period; this developed into the highly differentiated branch Integripalpia, which predominates in the recent fauna. He derives this group from the lower Annulipalpia (Hydroptilidae) and places the ancestral form of the tube bearers ("E") far away from the 3 preceding ancestral forms which developed into the lower Annulipalpia. Ross based the later evolution and differentiation of Integripalpia in his phylogenetic scheme on the characters of the adults; he gave fragmentary data on some characters of the larvae in a few cases. He divided the Integripalpia into 2 groups shown in his scheme as 2 differentiated branches which diverged early. In the recent fauna, he included the Phryganeidae, Limnophilidae, Plectrotarsidae, Goeridae, Brachycentridae and Lepidostomatidae in the first group; he includes all other families which he considered more specialized in the second group.

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* According to Ross (1956:10), the case of these larvae was saddle-shaped ("saddle-case").

Ross does not deal with the factors of the environment; he discusses the relation of Trichoptera to the water temperature in a special genetic scheme constructed like his general phylogenetic scheme. Ross considers the whole order, except the Xiphocentronidae, as originally cold-loving from the most
157 ancient times to the Cretaceous;* only later, in certain families, small branches of ecologically specialized forms appeared which became adapted to well-warmed (stagnant!) water bodies.

The eclectic character of Ross's scheme, which is based (except its hypothetical root) on isolated, not coordinated morphological characters of the different stages of development, makes it appear artificial. This explains the difference of opinion and contradictory data on the phylogenetic relationships of the families. For example, the Hydropsychidae have highly specialized larvae (more specialized than those of the other Annulipalpia); their adults have no ocelli, fly well, occur in large numbers and sometimes "flood" their habitat. This family is artificially placed between the most primitive Philopotamidae and Xiphocentronidae on one hand, and the Stenopsychidae on the other. This classification separates the closely related families Philopotamidae and Stenopsychidae and also the Xiphocentronidae and Psychomyiidae (Psychomyiinae of Ross), the larvae of which are closely related as shown recently (Edwards, 1961). This position of the higher Annulipalpia in Ross's scheme, as well as the relative position of all the other family groups of Annulipalpia which were derived by Ross from the ancestral form "A" (except the Philopotamidae), is completely artificial.

The difficulty of coordinating, in the same phylogenetic scheme, the evolution of adult Trichoptera and of their preimaginal stages arises from their adaptation to different conditions, either in the air or in the water. The explanation for the causes of evolution of different ontogenetic stages of insects should probably be looked for in the conditions of the environment and in the changed conditions in water bodies; the larvae develop at the bottom of water bodies; the winged insects live on the banks of water bodies, among the terrestrial fauna. Coordination of the causes of evolution of a species in either of the foregoing stages may have a different character; in some cases (Hydropsychidae) those which live in large streams in the plains evolve progressively in both stages; the larvae at the bottom of the river and the adults on the banks of the river predominate, sometimes "flooding" a locality. In other cases (Rhyacophilidae) progressive evolution is present only among the larvae and not among the adults; these adults lead a concealed life during their short existence (often only a few days),

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* In fact, this represents inhabitants of flowing water bodies originating from springs or from mountains.

hiding in cracks among stones, near tree trunks or among shrubs. Like a relict, the evolution of the adults of this family was retarded, so that we can establish only 2 large primitive genera (Rhyacophila and Himalopsyche) in the recent fauna, among the adults of the Rhyacophilinae; however, the diversity and morphological specialization of the larvae of Rhyacophila developing under the dynamic life conditions of streams are greater than the differences which in other groups became generic or even subfamily characters, e. g., different shape and size, presence or absence of gills, diversity of form of gills and anal legs and highly differentiated
158 primary chaetotaxy. There are highly specialized characters in the larvae of Rhyacophilidae, on the background of its general primitive character which resulted in the characters of the adults; this explains the recent flourishing and wide geographical distribution of the family. The high specialization of the larvae of some forms of the Palearctic Rhyacophilinae is even more sharply and widely expressed in the Australian subfamily Hydrobiosinae in the modification of the forelegs of the larvae into forceps or other structures.

In an article on phylogenetic relicts, Rohdendorf (1959) states the reason which explains the survival of ancient organisms under recent life conditions, i. e., the possession of certain useful specific characters; Rohdendorf (ibid.:50) writes: "The appearance of a few one-sided adaptations may prove so useful in the evolution of an ancient branch that it enables it to develop into a progressive, widely distributed group." Such is the family Rhyacophilidae, for example, the adults of which are nearly a phylogenetic relict according to its morphology and mode of life, while the highly specialized and progressively developed larvae have ensured the large number of species and wide geographical distribution of the family.

The primitive characters of organisms which do not correspond to the concept of phylogenetic relicts are retained in the same manner, e. g., in the highly progressive family Hydropsychidae.

A discussion on the primitive or specialized appearance of a group should be based on all characters of morphology, biology and its success; however, isolated primitive morphological characters of a group may be present throughout a system, in the different systematic categories.

Such characters are present in the Annulipalpia, both in the lower Rhyacophilidae and in the higher Hydropsychidae (and also to a greater or lesser extent in all intermediate forms). This is true also of the Integripalpia. In other words, primitive characters retained by the larvae of Trichoptera from ancestors are more or less characteristic for the lower families which are isolatedly represented and distributed in all ranks of the system.

We attempt to give below an at least one-sided representation of the main lines of the phylogeny of the order in the light of new data on the morphology and biology of the larvae, including the data in the systematic chapter.

To clarify this problem on the basis of the diversity of the characters of the various families, we shall attempt to define the phylogenetically important characters. We shall limit ourselves to the larvae of Annulipalpia as they are a more ancient and primitive suborder with clearer phylogenetic relationships among its families. The phylogenetic relationships among the families of Integripalpia are more complex and not sufficiently clear.

Siltala (1907:598—599) lists the primitive characters of caddis fly larvae. Without committing himself decisively, he mentions, among other primitive characters, the sclerotization of the dorsum in the form of small oval sclerites on the abdominal and thoracic segments (like those of the larvae of Stactobia, family Hydroptilidae). Siltala's assumption is probably correct; his view on the primary dorsal sclerotization of the larvae segments is supported by the relationships presently existing in the ontogenesis of the
159 genus Agraylea: the 1st-stage, 2nd-stage and 3rd-stage larvae of this genus (like the larvae of Stactobia) have dorsal sclerites on all abdominal segments, which later (in the 4th and 5th stage) disappear on segments 1—8. Nielsen listed a morphological analysis of the European species of Hydroptilidae. He found not only in Agraylea, but also in Hydroptila, Oxyethira and Orthotrichia, small tergites on the abdominal segments of the larvae; he writes about the abdominal tergites of Hydroptilidae: "These tergites must be regarded as a primitive feature" (Nielsen, 1948:190). Ross observed dorsal abdominal tergites as clearly marked as in Stactobia also in the larvae of Leucotrichia pictipes (Ross, 1944:120, Figure 449); Ulmer found such tergites in the larvae of Plethus cruciatus and Lamonganotrichia crassa (Ulmer, 1957:192—196, 200—203; Plates 14—15, Figures 94 and 114).

We are inclined to think that the presence of a tergite on the 9th abdominal segment retained in the larvae of the 3 lowest families of Annulipalpia (Rhyacophilidae, Glossosomatidae and Hydroptilidae) and to a small extent in the Hydropsychidae, and, in connection with case-bearing, is a primary phenomenon in most genera of Integripalpia, while the loss of this tergite is secondary.

The sclerotization of the meso- and metanotum should probably also be considered as primary, while the lack of sclerotization of the nota of these segments and of the dorsum of the abdominal segments should be considered secondary, developing with the increase of mobility of the larvae (which is determined by its mode of life). In the Annulipalpia, the lack of sclerotization of the larva is most completely developed in the active predators in the Polycentropodidae and in the higher Paleochaetoidea; the latter are tube-dwelling microphages which continuously move inside the tube, collecting microscopic food from the tube walls. The same also applies to the predators of the family Polycentropodidae, which move and build rapidly; they continuously renew their nets and actively prey upon the organisms caught in them.

The sclerotization of the meso- and metanotum of the larvae of the 3 other families of Neochaetoidea (Ecnomidae, Arctopsychidae and Hydropsychidae) is an atavism; in the Ecnomidae, the previously mentioned sclerites are thin and weakly sclerotized; in the Arctopsychidae, they are partly divided by a transverse suture which increases mobility. In the larvae of Hydropsychidae, the sclerotization of the meso- and metanotum is probably connected with life in their narrow dwelling chamber.

Among the tube-bearing Integripalpia, only the very mobile larvae of Phryganeidae, which live in broad, straight tubes open at both ends, lost the sclerites of the meso- and metanotum. Some genera however (Holostomis) retain rudimentary sclerites; in Yphria californica, these sclerites are not rudimentary but are already a small plate; in the more primitive Phryganopsychidae, the mesonotum is completely sclerotized. In the Molannidae and in the Arctopsychidae the mesonotum is divided by a transverse suture; the whole metanotum of Leptoceridae is membranous and the mesonotum is incompletely developed; it is reduced in some species to 2 small longitudinal rods. The Limnophilidae retain rudiments of the metanotal sclerites in form of small or larger sclerites; they also sometimes retain tergal sclerites of the 1st abdominal segment.

To summarize the foregoing and the data in the systematic chapter, and
160 to give a general picture of the phylogeny of the Annulipalpia based on data of preimaginal stages, we enumerate below the characters considered primitive.

### Full-grown larva

1. Small[*] or moderate size of the full-grown larvae with a general or partial resemblance to the 1st-stage larva.
2. A slightly flattened and elongate head.
3. Simple mouthparts with short mandibles with small denticles.
4. Deep constrictions between the body segments, which are of similar form.
5. All 3 pairs of legs are about the same length and form.
6. The dorsum of the thoracic and abdominal segments bear small sclerites of similar form.
7. The primary, primitive, unspecialized chaetotaxy consists of relatively long abdominal setae.
8. The moderately developed anal legs have a simple, short, curved claw.
9. There is no portable case.
10. The larvae live in tubular trenches in slowly flowing water.
11. The larva is microphagous.

### Pupa

1. Absence of anal lobes or rods.
2. Presence of a well-marked pupal cocoon.

The primitive character of the family Rhyacophilidae (except the Glossosomatinae) is generally accepted. The adult Rhyacophilidae have a primitive wing venation and a short life (only a few days); they lead an especially concealed mode of life hiding during the day near the shore in deep cracks among stones or near the base of dense shrubs. They do not feed and do not swarm; they die after copulation and oviposition. The larvae of this large family (over 300 species; Ross, 1956:115—126) are small, medium-sized or large in the later stages, leading a mobile life in rapidly flowing streams; they include species which are morphologically specialized within limits of the primitive structure of most of their organs, and within limits of the retention of their primary chaetotaxy which is completely primitive and poorly differentiated in the lowest forms (Hyporhyacophila group). The latter group includes species of Rhyacophila, the full-grown larvae of which have slightly flattened, subcylindrical and gill-less segments, with simple primary setae on the

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[*] The fossil Trichoptera of the deep Mesozoic and Permian were small (wing length 2.7—3.5 mm).

head and relatively long abdominal setae, a small dorsal sclerite of the 9th abdominal segment, slightly elongate and simple anal legs resembling those of the 1st-stage larvae; the group also includes some lower Rhyacophila which, unlike all the other forms of the group, are not predators but phytophages (Rh. laevis Botoşăneanu, 1956c:590–594), which do not build a pupal cavelike shelter (they are closely related to the Hydroptilidae).

The larvae of a part of the Rhyacophilidae is highly differentiated, but has not lost the primitive characters present in the whole family. The larvae of some groups lost the teeth of the mandibles; the abdominal segments are flattened, the integument relatively hard, and there are gills
161 of a varying degree of complexity; the 9th abdominal segment is markedly sclerotized; the anal legs are more complex and their sclerites bear crotchets and processes; the form of the claw is different; a more or less complex sculpture is present on the sclerites in some forms. In the higher forms, the primary chaetotaxy is markedly differentiated; it is specialized or reduced in some places; some setae on the legs and anal legs are transformed into spines and are sometimes movable. In spite of the complex structure of the higher Rhyacophilinae, the characteristic appearance of the larvae is retained in the whole order; the family can be identified even in the most highly specialized forms. The subfamily Hydrobiosinae, which is represented in the USSR by 1 genus and 2 species, shows a remarkably high specialization of the forelegs (see p. 321) but its abdomen shows the small size and cylindrical form characteristic of the lower forms.

The high specialization of the larvae of some species developed during adaptation to life under the diverse conditions in the highly dynamic environment of streams, including large turbulent mountain brooks and rivulets.

Thus, in spite of the high specialization of the larvae of some groups, the position of the Rhyacophilidae at the beginning of the sequence of families of the order may be considered well established.

The complex differentiation of the species inside a genus induced some authors to divide it into groups of species according to the structure of the larvae or according to the male genitalia (Döhler, 1950; Ross, 1956:75–126).*

The larvae of Glossosomatidae are more specialized, and differ markedly from those of Rhyacophilidae; the close relationship between these 2 families is most clearly marked in the pupae, which build a thick cocoon resembling that of Rhyacophila; this cocoon is enclosed in a similar cavelike pupal shelter. Unlike the larvae of Rhyacophilidae, the larvae of Glossosomatidae build a shieldlike portable case in the first stage, which (unlike the pupal case) has a ventral wall. The larvae show little resemblance to the larva of Rhyacophila; the head is prognathous but inclined downward (pseudohypognathism) because of the enlarged pronotum; the setae of the posterior part of the head's dorsal surface, which is covered with a process of the anterior margin of the pronotum, are displaced anteriorly and are grouped behind the eyes; several of these setae are markedly reduced. The secondary chaetotaxy of the pronotum (in some genera also of the mesonotum) is relatively rich; mesonotum and metanotum sometimes bear small dorsal sclerites. The abdominal segments are cylindrical and bear small setae. The dorsal sclerite of segment 9 is well developed, as in all the 3 lower families of Annulipalpia, which relates them to the Integripalpia; the anal legs are shorter than in the Rhyacophilidae with a downward-directed claw. Unlike the larvae of Rhyacophila, which can swim, the larvae of Glossosomatidae with their heavy portable case are not very mobile; they live on stones among algae on which they feed.

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* See pp. 132, 133.

The family Hydroptilidae is isolated from the 2 foregoing families in the morphology of the larvae. The larvae of Hydroptilidae resemble those of Glossosomatidae in several characters such as the sclerotized ventral side of the thorax, case-bearing, small size and feeding on algae. However, 162 the structure of the case is completely different; the case of Hydroptilidae is built in the 5th stage;* it consists of secretion, rarely has a primitive outer layer, and resembles the pupal cocoons of Glossosomatidae more than their heavy portable cases.** The 1st- to 4th-stage larvae have no case. A primitive character of the larvae is also their primary chaetotaxy, especially (in the 1st-stage larva) the long abdominal setae, the presence of dorsal sclerites on the abdominal segments, the absence of a portable case in the first 4 stages; the case of most forms is without any lining.

The primitive characters of the Philopotamidae are well marked; the larvae live in immovable tunnel-shaped cases; they are microphagous, their legs are short and of similar length and form; the abdominal segments are divided by deep constrictions; their cross section is round or slightly flattened; the abdomen is vermiform and long. As in the higher Annulipalpia, the sclerite of segment 9 is absent. The labrum is highly specialized, retractile and movable; its greater part is membranous and it bears a small medial sclerite at the base. Pupation takes place in the same cavelike cases as in Rhyacophila; however, the cases are less well constructed and are less solid; the pupa is situated in a loose cocoon inside the case.

The Stenopsychidae are closely related to the Philopotamidae; these 2 families were for a long time considered as 1 family. The Stenopsychidae differ from the Philopotamidae in size; the larvae are among the largest of Trichoptera; they live in tunnel-shaped tubes on pebbles in turbulent streams; they are microphagous; their body structure is simple as in the Philopotamidae; the abdomen tapers posteriorly; segment 9 bears a simple claw as in all Philopotamidae. Microscopic food is collected from the walls of the tube by the long, narrow head and the characteristic labrum, which is broad, short and has a dense brush of thin hairs at the anterior margin. The pupa is situated in a cavelike case which is built of small stones or large sand grains; the cocoon is loose.

We omit the Ecnominae in discussing the family Psychomyiidae, because this subfamily was separated as a family (Lepneva, 1956:16–26; Marlier, 1958:314). The larvae of Psychomyiidae live in tunnel-shaped tubes in slow streams; this was probably the mode of life of the order's ancestors. The body structure is simple; the forelegs are longer than the mid- and hind legs; the chaetotaxy of head, mesothorax, metathorax and legs is primary.

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* In distinction to Siltala (1907:390–391), who thought that the larvae of Stactobia build their case at the end of the 4th stage, Danecker, (1961:226), who studied the life history of Stactobia eatoniella and S. fuscicornis, confirms the fact that both species begin the building of the case only in the 5th stage; S. fuscicornis begins immediately after molting, and S. eatoniella 4 days later.

** Betten (1934:10) connected the membranous case of Hydroptilidae genetically with the pupal cocoon of Glossosomatidae and Rhyacophilidae; Nielsen (1948:188) does not recognize this homology.

The characters of specialization are as follows: 1) the labium is without palps; it is prolonged in form of a ligula which contains the spinning organ; the function of this organ is to build or repair the tubes, which are very long in the Psychomyiidae; 2) the trochantin is large, its distal part broad and spoon-shaped; it apparently takes part in food collection together with the labrum, mandibles and broad segments of the forelegs. The anal legs are simple; their claw is small and bent at a right angle.

The reasons for the separation of the Ecnomidae as an independent family
163 are given by Lepneva (1956). This family is related to the Psychomyiidae in the resemblance of their tunnel-shaped tubes; however, the Ecnomidae differ sharply from the Psychomyidae in their predatory mode of life and the morphological characters connected with this. The labrum and the chaetotaxy of the anterior part of the frontoclypeus resemble that of the predators of the higher Polycentropodidae; the structure of the thorax is primitive, i. e., meso- and metathorax are weakly sclerotized; the forelegs are typical raptorial legs with long segments; the chaetotaxy is mostly primary; there are few secondary setae on the coxa; the anal legs are longer than in Psychomyiidae; there are numerous secondary setae. The claw has a different form. The family Ecnomidae is closely related to the Polycentropidae in the larval mode of feeding and some morphological characters, and was at first considered a subfamily of the Polycentropodidae (Ulmer, 1909:228).

The larvae of Polycentropodidae* of the subfamily Polycentropodinae are predators, which is expressed in their morphology, the structures they build and their mode of life. The tunnel-shaped tube of the ancestors is represented only by its short base; the greater part of the structure consists of various types of traps, bags or funnels for the capture of planktonic and benthonic animals, especially larvae of Chironomidae and other insects. The primitive character uniting these forms with the larvae of the 4 previously mentioned families is the simple prognathous head with its primary chaetotaxy; the mandibles are the strong cutting organ of the predator; the long walking legs with their rich secondary chaetotaxy have the raptorial function of the predator; some of the setae form strong, thick, piercing organs; the numerous long setae are sense organs and have the high capacity for orientation which is necessary when waiting for prey. The anal legs are the longest existing in the Trichoptera; they support the larva when it catches the prey; both parts of section "a" of the anal leg have an abundant secondary chaetotaxy; the claw is long and slightly curved; the setae are markedly differentiated and some of them are reduced. Pupation takes place in a cavelike case built of small stones or sand grains which are usually loosely connected; the cocoon is loose.

An interesting character of this large family is that a small group of species of Holocentropus and Cyrnus, unlike the other Annulipalpia (except the Hydroptilidae), live in stagnant waters. The wide ecological range of the group in running water is shown by the fact that they live not onl in the rapid brooks and mountain streams typical for the subfamily, but in rivers in the plains and rivulets with dense thickets and also on the calm shores of lakes and in smaller, stagnant water bodies.

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* Only the Polycentropodinae are discussed, as this is the only subfamily which has well-studied larvae recorded from the USSR.

The families Arctopsychidae and Hydropsychidae are the most specialized groups of Annulipalpia; however, the larvae of these families retain a number of primitive characters which unite them with some lower groups. Such are the simple prognathous head of Arctopsychidae with its primary chaetotaxy; the free trochantin; the simple claw of the anal legs which resembles that of Psychomyiidae. We also consider the sclerotized meso-
164 and metanotum (as in Ecnomidae and Hydroptilidae) as primitive characters retained in the higher Annulipalpia together with their general high specialization. The predatory larvae live in narrow chambers (the most skilfully built chambers of the whole suborder), waiting for the prey, which they capture in netlike screens. The larvae are mobile, but live in a narrow space, which possibly contributed to the retention of the dorsal sclerites of the thorax. The Arctopsychidae are more primitive: as in the Polycentropodidae, the head is slightly elongate; the position of the tentorial pits is normal; the frontal sutures are curved at the point of the tentorial pits; there are only primary setae on the head, while the Hydropsychidae are the only family of Annulipalpia in which some genera have a large number of secondary setae on the head. The sclerotization of the meso- and metanotum of Arctopsychidae is slightly interrupted; the tergites of the segments are divided into 2 parts by a transverse suture, which increases flexibility.

Both families are highly specialized in all other characters:

1) a rich development of the secondary chaetotaxy of the legs and anal legs; long setae form typical groups at the base of the claw of the anal legs of the larvae;

2) the cutaneous appendages of the larvae are very complex; in the sclerotized parts of the body, the generally small covering setae have a very diverse form, from long setae on the sternites of segments 8 and 9 to various forms of minute needle-shaped cylindrical, stellate, tuft- and feather-shaped setae on head, thorax and legs; the membranous areas of the integument are also covered with small, dark covering setae;

3) the presence of characteristic ventral sclerites on abdominal segments 8 and 9, which are absent in all the other families; these sclerites bear posteriorly directed, strong covering setae which support the larva during its net weaving (see Figure 127).

According to the prevalence of primary or secondary chaetotaxy, the Annulipalpia are divided into 2 superfamilies: the Paleochaetoidea Lepn., and the Neochaetoidea Lepn. (Lepneva, 1956:14—21). These 2 groups differ in their method of feeding, mode of life, the structures they build, their general morphology and the chaetotaxy. Primitive characters predominate in the Paleochaetoidea, specialized characters in the Neochaetoidea. The Paleochaetoidea include the Rhyacophilidae, Glossosomatidae, Hydroptilidae, Philopotamidae, Stenopsychidae and Psychomyiidae; to the same group also belong the tropical American Xiphocentronidae, the larvae of which are closely related to the Psychomyiidae. The Neochaetoidea include the Ecnomidae, Polycentropodidae, Arctopsychidae and Hydropsychidae. All Neochaetoidea are predators; the last 3 families of the group build capturing nets; the Ecnomidae weave simple tunnel-shaped tubes; they are predators which live in primitive tubular structures like the higher Paleochaetoidea; the secondary chaetotaxy of the Ecnomidae larvae is less well developed than in the 3 higher families of the Neochaetoidea. The Ecnomidae are the lowest family of Neochaetoidea and its larvae are the least specialized. 165 The Hydropsychidae are the highest family of Neochaetoidea; they are most specialized and their secondary chaetotaxy is the most abundant.

A general picture of the phylogeny of the Annulipalpia and the phylogenetic relationships among its families according to the early stages of development is given in Figure 168.

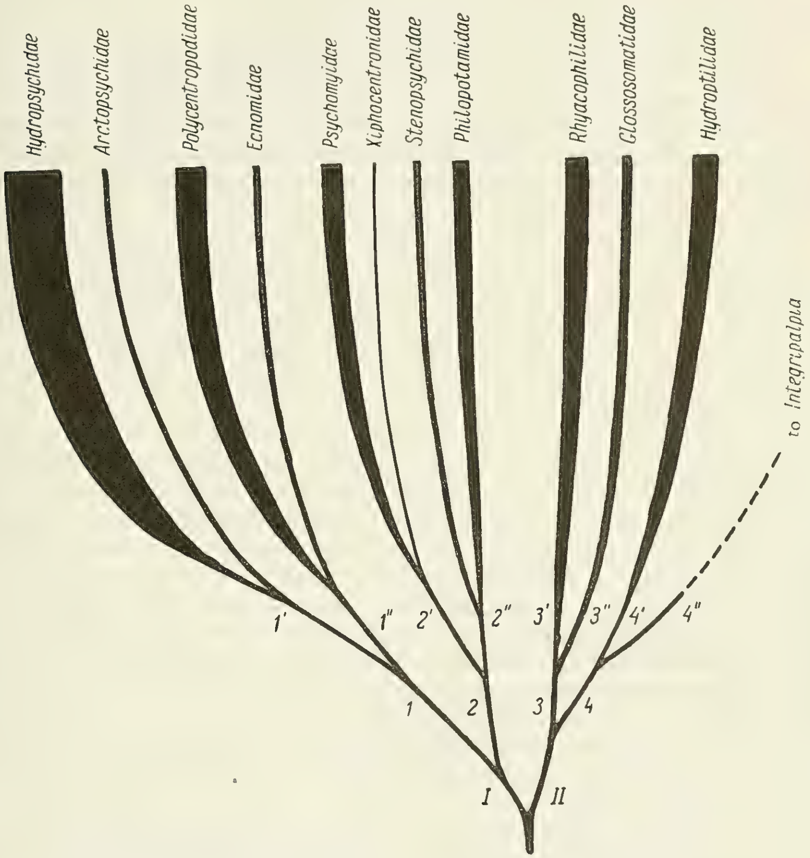

FIGURE 168. Phylogenetic scheme of the Annulipalpia:

I – larvae living in fixed shelters; II – free-living larva with or without portable cases. 1 – predators, most of which build capturing nets; 2 – microphages building tunnel-shaped tubes; 3 – shieldlike cases; 4 – sacciform or tubular cases. 1' – screenlike capturing nets; 1'' – capturing net (if present) funnel-shaped; 2' – labium prolonged in form of a ligula; 2'' – labrum membranous or with a brush; 3' – only the pupa has a shieldlike case; larvae without cases; 3'' – larvae living in portable, shieldlike cases; 4' – case saclike, built only of secretion or of secretion with a thin outer layer of small mineral or plant particles; 4'' – tubular case with an outer layer of varying structure which is often coarse, unwieldy and consists of large mineral or plant particles.

As in the scheme of Ross (1956:10, Plate 1), the lower Paleochaetoidea (Rhyacophilidae, Glossosomatidae and Hydroptilidae) have an intermediate
166 position between the Annulipalpia and Integripalpia; this classification is based on the fact that the larvae of these lower Annulipalpia have retained some ancient characters in common with the Integripalpia. The other part of the scheme consisting of the higher Paleochaetoidea and all Neochaetoidea differs from the scheme of Ross; it expresses a different point of view on the systematic structure of the suborder and the phylogenetic relationships between the families.

The phylogenetic scheme is based on the foregoing data and systematic data; the main characters used are the morphological characters of the larvae, the degree of primitiveness or specialization, especially of the chaetotaxy, method of feeding, the character of built structures, and the position in the system in the light of known phylogenetic relationships between the family groups. The relative size of the groups is shown by the thicker or thinner branches based on the data given by Fischer (1944) until 1938, with some modifications based on later data (see p. 131).

We suggest that the primitive larva of the ancestors of the order was a small campodeiform larva with a simple primary chaetotaxy, with simple legs of similar form, and without gills, which resembled remotely the 1st-stage larvae of the recent Rhyacophilidae or Hydroptilidae; this larva had, like the Hydroptilidae, small sclerites on the dorsum of the abdominal and thoracic segments.

It is not important whether this primordial form was microphagous and lived in immovable, attached tubes like the larvae of the recent Phylopotomidae and Psychomyiidae, or lived freely, with a different type of phytophagous life. We are interested in the trends of primary divergence of the larvae of the ancestors of Trichoptera; one of these trends (stem I) resulted in the further development of the inhabitants of immovably attached shelters; the second trend (stem II) resulted in the development of free-living forms, most of which built portable cases. Development of the first trend resulted later in the appearance of very mobile microphagous and predatory forms; development of the second line resulted in the development of a large group of sluggish case bearers. The structures of Trichoptera which are attached at one place necessitate that their inhabitants be mobile; the bearing of a case which is often bulky restricts the mobility of the larva.

Evolution along stem I diverged in 2 lines: line 2 is the conservative line of development in which the primary method of feeding (microphagy) and the life in simple tunnel-shaped tubes were retained; line 1 is a progressive line connected with a change to a predatory life and with the transformation of the simple tunnel-shaped tubes into complex capturing structures.

The evolution of families along line 2 was reduced to the improvement of the organs collecting food from the walls of the tube and ensuring the building activity of the larva. In the recent fauna, evolution along branch 2'' resulted in forms with a membranous labrum characteristic for the larvae of Philopotamidae (with a rudimentary dorsal sclerite at the base) or in forms with an elongate head and broad, short labrum with a dense brush of hairs at the anterior margin characteristic for the larvae of Stenopsychidae; in the recent fauna, evolution along branch 2' resulted in the appearance of the families Xiphocentronidae and Psychomyiidae with a labium without palps 167 and prolonged in form of a ligula which contained the spinning organ; this organ facilitates the construction and repair of the long tunnel-shaped tube of the larva.

Evolution along line 2 (line of the higher Paleochaetoidea) took place under conditions of a concealed but very mobile mode of life inside tubes; connected with collection of microscopic food from the walls of the tube; the chaetotaxy (except that of the pronotum) remained mainly primary; the membranization of the dorsum extended to the last 2 thoracic segments and all abdominal segments, including segment 9.

The group includes 2 pairs of phylogenetically related families; on branch 2'', these are the relatively large and primitive family Philopotamidae and the small family Stenopsychidae with 47 species in the world fauna (the Stenopsychidae were separated from the Philopotamidae); branch 2' contains the relatively large family Psychomyiidae and the small family Xiphocentronidae, which consists of only 4 species, which survived in tropical Central America.

Evolution along phylogenetic line 1 of stem I took place during the change from phytophagy to a predatory life; this change was also expressed in the transformation of the primitive tubular shelters into complex capturing structures of various types (see p. 77). The development of a predatory life required a number of morphological and physiological adaptations, particularly the development of mobility and strength of the predator, and an increase of its capacity for orientation. This was attained by the development of a rich and highly differentiated secondary chaetotaxy. The development of a group of predators in the Annulipalpia was, therefore, closely connected with the development of the secondary chaetotaxy, or, in other words, with the development of the superfamily Neochaetoidea.

The change to predatory life could take place inside the tunnel-shaped tubes, as in the recent Ecnomidae; this family consists of predators which continue to live in the same tunnel-shaped tubes which are characteristic of microphages. The structures of some genera of recent Polycentropodidae (Plectrocnemia, Polycentropus, Holocentropus) retain even at present a rather large tube part in which the larva waits for its prey and maintains the good condition of the net; the tubular part of the structure of Neureclipsis (which is situated at the apex of the funnel) is not longer than the larva (Figure 123). The dwelling chamber of the larvae of Arctopsychidae and Hydropsychidae is broad and short; the tube is transformed into a saclike shelter; the capturing structures of these 2 families do not form a funnel (a modified tube) but is a flat and skilfully woven screen resembling a plankton net. The development of gills of the larvae of Arctopsychidae and Hydropsychidae is also connected with their life in a narrow space.

The morphological specialization of the predators is expressed in the adaptations for capturing and retaining food; the toothed mandibles of all 4 families of predators are a strong organ; the legs are used to catch and hold the prey; some setae of the primary chaetotaxy and of the rich secondary chaetotaxy of the legs are transformed into short, massive, spear-shaped or spinelike organs which kill the prey. The rich secondary chaetotaxy of the higher Neochaetoidea (Arctopsychidae and Hydropsychidae) is mainly concentrated on the legs; in the Hydropsychidae (unlike all other

Annulipalpia) it is also concentrated on the head; the Arctopsychidae have a relatively primitive form of the head which is slightly elongate and slightly 168 flattened with a simple frontoclypeus, and has a notch near the tentorial pits; the head of Hydropsychidae is short, broad, often flattened dorsally; in some forms it has a crown of secondary setae which probably take part in the collection of food from the screenlike nets. In addition to the abundant secondary chaetotaxy (especially on the head of Hydropsychidae), both families have a highly differentiated series of cutaneous appendages in the form of minute covering setae which may be either thin, light, hairlike or short, thick, flattened, branched or sometimes of a peculiar or complex form; this relates these higher Annulipalpia by convergence to some Integripalpia (Limnophilinae).

The membranization of the body of the mobile predators is especially well marked in the predatory larvae of Polycentropodidae; like the higher Paleochaetoidea, these larvae lost all dorsal sclerites of the abdomen (including tergite 9) and of the meso- and metanotum. The larvae of the 3 other families living in a narrower space lost the dorsal sclerites of the abdomen but retained the sclerites of the meso- and metanotum: the Ecnomidae retain them in the form of thin sclerites with a simple primary chaetotaxy, and the Arctopsychidae in the form of sclerites with transverse sutures; the Hydropsychidae retain them in the form of large, hard sclerites approximating this highest family of Annulipalpia to one of the groups of the lower Paleochaetoides (Hydroptilidae).

Evolution along line 1 of the ancestral stem I took place in the early branches 1' and 1''; these two branches differ in the larvae in the form of the capturing nets, the method of catching prey and corresponding morphological adaptations, especially the development of the secondary chaetotaxy, its distribution on the body and the forms of specialization. The groups which evolved on branch 1'' have few cutaneous appendages of the type of small covering setae; they may be called "smooth groups"; the groups which developed on branch 1' have a rich development of such cutaneous appendages and may be called "spiny groups." In the recent fauna, each of the foregoing divisions consists of two related families: one is small and very ancient, and one is large and very recent and flourishing; in branch 1'', these are Ecnomidae and Polycentropodidae; in branch 1', these are Arctopsychidae and Hydropsychidae.

The small ancient family Ecnomidae is restricted mainly to the subtropics and tropics of Eurasia and Africa; the larvae are the most primitive among the Neochaetoidea; its secondary chaetotaxy is little developed and its structures are primitive tunnel-shaped tubes; its ecological range is restricted to water with a slow current or to stagnant water. The large family Polycentropodidae is distributed almost throughout the world; it is an ancient branch which separated from the ancestors of Ecnomidae; it is now highly differentiated and flourishing, which is to a large extent the result of the high morphological specialization of the predatory larvae with its skilfully built capturing nets and its wide ecological range which covers biotopes in small water bodies in caves, various types of flowing water (including large rivers in the plains and stagnant water),

In the higher Neochaetoidea, which developed on branch 1', the Ecnomidae are replaced by the small ancient family Arctopsychidae (about 20 species),

which is distributed in the Holarctic region; the larvae of this family retain certain primitive characters (simple shape of the head and its primary chaetotaxy). The most recent, highly progressive branch of the ancestors of
169 Arctopsychidae is the now flourishing family Hydropsychidae; this family is distributed throughout the world; it is the largest family of Annulipalpia (according to data to 1944 it contains 646 species) and the second largest family of the Trichoptera;* the larvae are highly specialized and have a rich secondary chaetotaxy, including minute covering setae extending to the head (which is rare in Trichoptera). The larvae of Hydropsychidae live only in flowing water;** however, the ecological range of the family is unusually wide, including shallow, slowly flowing brooks, mountain streams of various types, and large rivers in the plains, the bottom of which is densely inhabited along thousands of kilometers with larvae of Hydropsychidae; the adults of these species of higher Neochaetoidea often "flood" the area.

The evolutional trend in the original stem II represents the development of some groups, the larvae of which ceased to live in immovably attached tunnel-shaped tubes and changed to a free and mobile life, building portable cases or living without cases. The further evolution in this direction (as in stem I) was determined by the method of feeding of the larvae and the character of their building activity. The primary divergence of stem II found expression in the development of the larvae of the ancient Trichoptera along two different lines: line 3, which resulted in the recent fauna in builders of shieldlike cases resembling the pupal cases of some inhabitants of tunnel-shaped tubes, and line 4, which resulted in the builders of a different type of portable cases.

According to the method of feeding, the later evolution along line 3 took two different trends: branch 3' developed into predators and branch 3'' into algophages. In the recent fauna, branch 3' developed into the Rhyacophilidae, which is the only family of the whole complex which developed in the direction of stem II; this family is closely related to the inhabitants of immovable tubular shelters in the absence of a portable case, in their general appearance and in their biological cycle; the larva ends its feeding and growth period in the 5th stage; it begins to build its shelter from mineral particles only then; the larva pupates in this shelter; the same is done by the inhabitants of immovable structures; some of these, e. g., the Stenopsychidae and some species of Hydropsychidae build pupal shelters as skilfully and strongly as the Rhyacophilidae. The rudiment of the tunnel-shaped tube of the other Paleochaetoidea is possibly represented in Rhyacophila by a filament which is produced from the 1st stage onward, and dragged behind the larva when it moves (this filament is attached to different points on the body of the larva). A closed pupal cocoon built of thick tissue is a characteristic phenomenon inside the case in the recent fauna only in the Rhyacophilidae and the closely related Glossosomatidae, i. e., the two families of the genetic line 3.

For the first time in the history of the larvae, in the family Glossosomatidae (branch 3''), building a case (resembling the pupal case but portable and with a ventral wall) begins in the first larval stage and continues

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* After the Limnophilidae with 676 species (Schmid, 1955).

** If isolated species are excluded which occur also in the open surf at the shore of large lakes.

170 throughout life. The case-bearing habit and feeding on algae are connected with a nonactive life on stones among algae; they have a marked effect on the structure of the body of these ancient case bearers, making them slightly similar to the larvae of Rhyacophilidae; however, a number of morphological details and the close resemblance of the pupal case and cocoon (which is a sort of reduced replica of the case and cocoon of the pupa of Rhyacophilidae) prove the close relationships between these families.

The membranization of the mobile larvae of Rhyacophilidae, which do not build a portable case, is developed almost as completely as in the higher Palaeochaetoidea, affecting the dorsum of all abdominal segments except segment 9 and the meso- and metanotum, which bear small sclerites in some genera of Glossosomatidae.

The development in line 4, which depends on the method of feeding, the time at which building begins and the form of the case, is expressed in the differentiation of branches 4' and 4''. In branch 4' developed algophages living without a case in the early stages of development, and building a portable sacciform case at the beginning of the 5th stage; this case is without a lining or has a lining of thin, minute particles which are later used to build the pupal case. Branch 4'' developed into detritophages with a tubular portable case with a rich, often bulky, outer layer; this case is built beginning from the 1st-larval stage. Branch 4' developed in the recent fauna into the family Hydroptilidae. Branch 4'' is considered the ancestor of the whole suborder Integripalpia; this is thus a very recent, highly progressive, and differentiated branch of Trichoptera.

Line 4' remained conservative; recent species of Hydroptilidae retained a number of very primitive characters of the assumed ancestors of the order; such characters are the small size, the complete dorsal sclerotization of the thorax (in some genera, also of the abdominal segments), and the predominance of the primary chaetotaxy.

The pupal case of Hydroptilidae is transformed from the larval case; the insect also builds a pupal cocoon; however, it is not well defined and is not separated from the inner lining of the pupal case.

In the recent Hydroptilidae, the specialization developed during evolution along line 4' is expressed in the highly differentiated primary chaetotaxy; for example, seta 8 of the claw of the anal leg of Ithytrichia lamellaris has a very unusual spatulate form; the distal dorsal setae of the anal leg of Agraylea multipunctata are unusually long in the 4th stage.

The larvae of most species (including species of Hydroptila) keep a close connection with flowing water; however, some genera, e. g., Agraylea, Oxyethira and Orthotrichia, which feed on filamentous algae, widely inhabit stagnant water; life in such a habitat is observed much more rarely among the other Annulipalpia, i. e., only in the Polycentropodidae.

Branch 4'' consists of tube-bearing detritophages; this is an ancestral branch which, during its progressive evolution, developed into the 19 families of recent Integripalpia. The high rate of evolution of Integripalpia (branch 4'') connected with the complex morphological specialization and with the extension of the ecological range of the group was ensured by the available nutritive food in the form of detritus with its rich fauna of fungi
171 and bacteria and which is abundant throughout the year in the most diverse habitats of Trichoptera and also by the high development of their building art.

While the Integripalpia remained, like the whole order, mainly rheophilic freshwater inhabitants, their larvae not only settled widely in the most diverse biotopes of flowing and stagnant waters, but also spread into the brackish water of lakes and marine coasts, and even in a few cases, into the open littoral of the ocean.

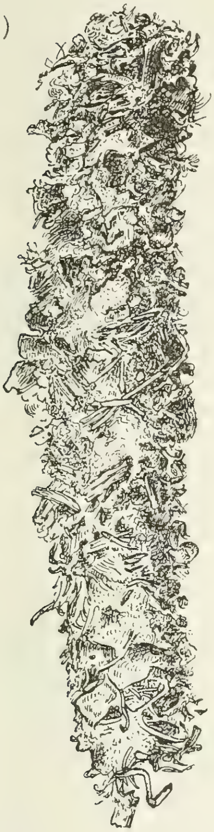
FIGURE 169. Larval case of Phryganopsyche latipennis Banks (after Wiggins)

(172) Life in a portable case changes the whole appearance of the larva. Hypognathism develops; the tibiae and tarsi of the hind legs of some forms become gradually longer, developing into characteristic sense organs which are held outside the tube while the body of the larva remains in the tube. With rare exceptions, the tube bearers retain the mesonotal sclerite, and in most forms, also rudiments of the metanotal sclerite. The body, which is covered by the tube, loses to a large extent its mobility and the deep separation of the segments. The segments of tube bearers are separated only by shallow intersegmental grooves; gills and a lateral line appear; the dorsal sclerite of segment 9 is retained in the form of a small sclerite, with rare exceptions. The anal legs are very short; the claw becomes small and simply curved; it functions as a lateral, retaining hook, holding the larva to the inside of the case wall. The larva becomes eruciform.

The case of most forms (unlike that of Glossosomatidae) is differentiated into anterior and posterior ends and tapers gradually posteriorly; the anterior opening is wider than the posterior; the posterior opening is usually covered at the margin with a membrane with a small opening in the middle; this opening is round or of a different form.

The primitive case of the ancient tube bearers probably resembled the case of the recent Phryganopsychidae; these cases are simple, straight, relatively wide tubes with a covering of minute detritus particles (Figure 169), or the larvae make the covering from other remains of animals and plants. The hypothesis that plant material is the primary material for the covering of the primitive structures of the first tube bearers is supported by the fact that the larvae of recent Trichoptera (species of Chaetopteryx, species of Stenophilacini and some species of Limnophilus) use detritus and plant particles in the early stages but begin later to use mineral fragments; the anterior part of the cases of the full-grown larvae of these species consists of mineral particles, while the posterior part, which was built earlier, consists of vegetable particles. The use of detritus particles taken without selection for the covering of the case thus represents the primary method of building the tubular case. The covering of the case is also made without selection by the 1st-stage larva of Limnophilus and Phryganea or by the larvae of the species of the preceding families when they are removed from the case and when they renew the lost shelter. The later complication of the building is expressed in the selection of the most suitable detritus particles or of those with the most uniform shape (e. g., in Limnophilus). This complication is expressed in the preliminary processing of the building material such as biting off small twigs, or cutting pieces of stalks and leaves into a definite shape; this processing of the vegetable fragments often results in the complex case of eruciform larvae, which is a mimicry, and such a case is an example of the most recent high specialization of the building.

172 The same evolution took place in the building of structures from mineral particles; the mineral particles were first used without selection; the insect then began to make a selection which was often meticulous and accurate, resulting in the mosaic structures of Molannidae or in the smooth tubes of Dicosmaecinae and Stenophilacini, which are covered with sand grains of uniform shape.

The development of the case-bearing habit in the Integripalpia markedly enlarged the adaptive possibilities of the suborder. The adaptation to new conditions did not require a full morphological reconstruction of the body; in some cases, a change of the form of the case and its method of building were sufficient.

The Trichoptera are from time immemorial adapted to life in flowing water; as already repeatedly stated, it also remained such with the Integripalpia. The tubular shape of the case with its solid walls enabled the tube bearers to create an artificial water current inside the case by rhythmic movements of the body; this facilitated the extension of the ecological range of the larvae of species of Integripalpia; this also extended the geographical range by enabling it to spread into stagnant water. The family Phryganeidae, which is specific for stagnant water, developed; this family has not lost its connection with water with a slow current to the present time. The largest of the 4 tribes of the subfamily Limnophilinae (Limnophilini) is also restricted to stagnant water (the other 3 tribes of the subfamily live in flowing water). Among the water bodies inhabited by species of Limnophilini there are very shallow water bodies, including temporary marshes and puddles in spring. Some species of Integripalpia are adapted to life in very shallow water among tree remains and fallen leaves in flooded areas of springs, or they live in the splash zone, belonging to the fauna of wet stones and mosses.

The ecological range of the suborder became further enlarged beyond the water; it spread to littoral and even more remote biotopes, e. g., the species of Ironoquia (Limnophilidae) came out of the water to pupate; the genus Enoicyla (Limnophilidae) lives outside the water in all stages of development, so that it is a true terrestrial species.

Authors apparently unanimously consider the Annulipalpia as more primitive than the Integripalpia. An analysis of the relationship in the early stages of development shows that the Integripalpia should also be regarded as less independent; they should be considered a stem equivalent to the Annulipalpia (as shown in Martynov's phyletic scheme of the insect orders (1938: Plate 1)); Martynov derives the Lepidoptera from Integripalpia; the
173 Integripalpia should be considered in analogy as an ancient branch of the Annulipalpia. According to their origin and position in the classification of the recent fauna, the Integripalpia are more closely related to the lower Paleochaetoidea, especially to the Hydroptilidae. The latter family also has a tendency to bear a case in its phylogenesis (but in a different form).

The Integripalpia developed progressively under conditions of abundant food and high adaptive possibilities to extend their ecological range; they are represented in the recent fauna by 19 families. We describe the larvae of 11 families of the 12 families occurring in the USSR in the next part of this work.

The phylogenetic relationships between the family groups of Integripalpia are much more complicated in the larvae than in the Annulipalpia; the family groups proposed by various authors (based on the characters of the early stages of development) are not convincing.

To the family groups with relatively primitive larvae, which have simple, unspecialized sclerites and a little varying form of the legs, belong the Phryganeidae, Phryganopsychidae, part of the Limnophilidae (Drusinae) and the Lepidostomatidae; to the group of highly specialized families with a rich secondary chaetotaxy of the legs, which is sometimes completely different on different legs both in form and function belong the Odontoceridae, Calamoceratidae, Molannidae, Leptoceridae, Beraeidae and Sericostomatidae; Goeridae and Brachycentridae are intermediate between the 2 aforementioned groups.

The phylogenetic scheme of the Annulipalpia in Figure 168 is based on the morphology, biological characters and phylogenetic relationships of the families in the larval and pupal stage and is therefore an attempt to show the lines of evolution in the early stages of development.

We shall now attempt to combine this phylogenetic scheme with at least some of the characters of the adult insect; we select for this the structures used also by earlier authors, i. e., the form of the last segment of the maxillary palps and the presence or absence of ocelli.

According to the presence of an undivided, slightly elongate segment of the maxillary palps, the lower Annulipalpia (Rhyacophilidae, Glossosomatidae and Hydroptilidae) are related to the Integripalpia; they differ in this character from all Neochaetoidea and the higher Palaeochaetoidea (the "true campodeid forms" separated as a group by Klapálek). The possession of an undivided maxillary last palp segment is a character of some Annulipalpia which suggests the ancient genetic relationship between the 2 suborders. This is even more clearly marked in the larvae in a number of other characters, including such important characters as the case-bearing habit and the presence of a dorsal sclerite on abdominal segment 9.

The presence of ocelli in the Annulipalpia is characteristic for the families of the part of the phylogenetic scheme which contains the most primitive forms, i. e., all Palaeochaetoidea, except the highest family of this group, the Psychomyiidae. In the Integripalpia, ocelli are characteristic only for families with relatively primitive larvae which are placed immediately near the lower Annulipalpia, i. e., the Phryganopsychidae, Phryganeidae and Limnophilidae; all the other families of the order, except the Plectrotarsidae, are without ocelli.

174 We may thus conclude that both the above characters of the adult Trichoptera are directly correlated with the degree of primitiveness or specialization of the same families in the larvae.

## ECONOMIC IMPORTANCE

The larvae of Trichoptera, which live on the bottom of various water bodies, are one of the food sources of bottom-feeding fish; they are a principal, supplementary or accidental part of their food. Certain predatory fish (especially their young) also feed sometimes on Trichoptera. The most useful food are the large species which appear in great numbers. In the open littoral of lakes, these are various species of Limnophilinae and Apataniinae, especially species of Potamophylax, Chaetopteryx, Anabolia, Dicosmoecus and Apatania. In plant thickets, these are species of Phryganea, Agrypnia, Nemotaulius and Grammotaulius, and also numerous small species of Leptoceridae and Hydroptilidae, which inhabit plant thickets of lakes, rivers, reservoirs, ponds and water bodies of river floodlands.

We give herewith some data on the role of Trichoptera as food of some benthon-feeding fishes of the USSR.*

The larvae of Hydropsychidae, which occur in large numbers on the bottom of large rivers in the plains, are an important part of the diet of Acipenseridae. In the Volga, Acipenser ruthenus ruthenus begins to feed on Trichoptera when it reaches a length of 4–8 cm; in its later life, it feeds on larvae of Hydropsyche sp. sp. (mainly H. ornatula). According to observations made in 1934 in spawning grounds in the middle Volga, in the area of Kazan, larvae of Hydropsyche are the largest invertebrates in the diet of Acipenser ruthenus. In the Kuibyshev region (according to data from 1939) in some places, these larvae constitute up to 50% of the food of this fish; in the stomach of 1 specimen, 144–350 larvae of Hydropsyche were found (Bening, 1912:7–11; Aristovskaya, 1935a:147; 1935b:47–49; Pankratova, 1948:610–613). The same applies to the Siberian sterlet (Acipenser ruthenus ruthenus natio marsiglii). To judge from the frequency of occurrence of Trichoptera in the stomach of sterlets in the upper and middle Ob, and the avidity with which they are eaten by sterlets, these insects take first place in the diet of this fish (Solomonovskaya, 1952:69–70). In the Irtysh, the food of this fish consists mainly of Tendipedidae, mayflies and species of Hydropsyche and Brachycentrus subnubilus; in the lower reaches of the river, during the summer, an average of 52 specimens was found in the stomachs of sterlets in some localities. Trichoptera constitute about 12% of the food of sterlets in early August and 28.8% in mid-August (Chalikov, 1928:16–17; Revnivykh, 1937:261–267; Sal'dau, 1949:202–203). The food of the Siberian sterlet includes Trichoptera all along the Yenisei; 194 specimens are sometimes found in the stomach of this fish (Isachenko,** 1916:5–6; Romanova, 1948:152).
175 Trichoptera were also found in the stomachs of Acipenser baeri in the Ob and Yenisei (Solomonovskaya, 1952:66–68). In the Irtysh, Trichoptera occur constantly in the summer diet of the sturgeon; this fish prefers larvae of Brachycentrus subnubilus (Chalikov, 1930:1–2;

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* The literature on the feeding of fish is large; we are using here only Russian works, selecting only works in which the role of Trichoptera as food is well described.

** Isachenko (1916) apparently was mistaken when he described the larvae of Phryganeidae as the predominant food of sterlets in the Yenisei. When Hydropsychidae are abundant in the Yenisei, there are no larvae of Phryganeidae in the river, as shown by the observations of P.L. Pirozhnikova and others (Lepneva, 1948b: 71–86).

Revnivykh, 1937:267–273). The important role of Trichoptera in the food of the Amur sturgeon (Acipenser schrencki) has been known for a long time; large numbers of caddis flies, mayflies, stoneflies and Diptera cover the stones and tree stumps; these insects have obtained the popular name of "sturgeon food" on the Amur (Soldatov, 1914–1915:238–239). In the Zoological Institute collections, there is a sample of about 200 specimens of large larvae of Aethaloptera rossica obtained in 1912 by Soldatov from the stomach of a sturgeon from the Amur. The rich food supply on the bottom of the large rivers of Russia can be inferred in summer from the multitudes of adult mayflies and caddis flies seen taking wing (see p. 168).

Trichoptera abundantly inhabit the stony bottom of the littoral of large oligotrophic lakes and clean cold-water mountain brooks and rivulets; they are, therefore, a constant part of the food of Thymallidae and Salmonidae. Salmo trutta morpha fario, the Amu Darya trout (S. trutta oxianus) and Thymallus thymallus feed on larvae and adults of Trichoptera and other insects. These fish jump out of the water to catch the adults or collect them from the water surface when they hatch or lay eggs. In the rivers of the Kola Peninsula, e. g., the Mesna River (Svetovidov, 1936:234) the European grayling frequently feeds on Trichoptera (relative frequency = 25%); the same was observed in the Narva River (Arnold, 1912:56–57). In Lake Teletskoe, Trichoptera constitute 48.8% of the food of Thymallus arcticus, the stomach of which is sometimes filled with larvae of Dicosmoecus palatus; this species swallows the larvae together with their massive cases (Solomonovskaya, unpublished data; Lepneva, 1949:111). In the Yenisei and its tributaries, to 44% of the food of the Siberian grayling consists in some localities of Trichoptera, including species of Hydropsyche, Leptoceridae and Limnophilidae (Isachenko, 1916:32–47; Romanova, 1948:186). Thymallus arcticus baicalensis and Th. arcticus baicalensis infrasubsp. brevipennis feed also on Trichoptera which are found in large numbers on stones in the open littoral of the lake (Kozhov, 1934:119, 123–125; Berg, 1948:426; Svetovidov, 1931:72). Th. arcticus grubei constantly feeds on Trichoptera, which constitute 0.8–27.3% of its food; in the Amur, this species feeds on larvae of the species of Rhyacophila, Hydropsyche nevae, Macronema radiatum, Goera sp. and Leptoceridae (Klyuchareva, 1952:368–370).

Trichoptera are an important part of the food of many whitefish. In the Ukhta lakes of Karelia (Upper, Middle and Lower Kuito) Trichoptera are often predominant in the food of Coregonus lavaretus karelicus. Young specimens weighing 0.2–0.6 kg (3–4 years old) feed mainly on small larvae of Leptoceridae (Oecetis lacustris, Leptocerus cinereus); as many as 192 specimens have been found in a stomach; the solid cases of Oecetis pass through the intestine of fish almost intact. Large whitefish, 5–12 years old and weighing 0.6–1.4 kg feed on large larvae; they prefer Phryganeidae (Phryganea striata, Agrypnia obsoleta), which they swallow together with their cases covered with plant fragments (which become much changed in the intestine of the fish); one often finds
176 more than 50 large larvae (sometimes even 295 specimens) in the stomach of 1 fish. Whitefish rarely swallow larvae of A. pagetana and Molanna angustata; the thin wings of the case of Molanna are destroyed in the

intestine of the fish, and the whole case disintegrates into separate sand grains (Gerd, 1935:113–116, 142). The following whitefish include in their diet Trichoptera: the Onega River (Coregonus lavaretoides, C. lavaretusludoga, C. lavaretus widergreni), C. lavaretus (C. lavaretoides natio sunensis), C. lavaretus maraenoides, C. lavaretus imandrae (Gerd, 1951:90–93; Kozhin, 1929:218–219; Krogius, 1926:151).

Trichoptera are a constant, sometimes important, part of the food of various whitefish in the Ob; Trichoptera take second place after Crustacea in some localities in the diet of C. tugun during the foraging period; larvae were found in the stomach of C. peled, C. muksun, C. nasus and the C. lavaretus pidschian (Sal'dau, 1949:180–183, 189–192); Trichoptera are constantly found in the stomachs of the Lake Teleteskoe whitefish (C. lavaretus pidschian var. smitti)* in the upper reaches of the basin; the stomach of some fish is filled with larvae of Apatania stigmatella and Anisogamodes flavipunctatus (Solomonovskaya, 1952; Lepneva, 1949:110). Trichoptera are also part of the food of whitefish in the Yenisei (Isachenko, 1916:31–32; Romanova, 1948:154–174).

Brachymystax lenok in Lake Teletskoe feeds avidly on Trichoptera, which form about 80% of the food of this species; it may swallow to 72 large larvae of Dicosmoecus palatus (according to Solomonovskaya; cf. Lepneva, 1949:111); Limnophilidae were found in the food of the lenok in the Biryusa (a tributary of the Yenisei) (Isachenko, 1916:10); in the Amur and its tributaries, larvae of Trichoptera form about 16.5% of the food of the lenok; 200 specimens are sometimes found in the stomach of this species; the lenok swallows larvae of Stenopsyche griseipennis, Arctopsyche amurensis, Hydropsyche nevae, Hydropsyche sp., and species of Polycentropodidae, Psychomyiidae, Leptoceridae, Limnophilidae and Sericostomatidae (Klyuchareva, 1952:367–369; Levanidov, 1951:75–76).

Cyprinus carpio, Rutilus rutilus, R. rutilus lacustris, R. rutilus aralensis, Abramis brama and Leuciscus idus feed on Trichoptera and other insects. Trichoptera constantly appear in the food of Leuciscus leuciscus baicalensis in the Ob and Yenisei. About 50% of the summer food of this consists of Trichoptera in Lake Teletskoe (Isachenko, 1916:60–63; Romanova, 1949:25–29; Sal'dau, 1949:204–211; Solomonovskaya, 1952:71–72; Spanovskaya, 1948:41–43; Shevchenya, 1940:100–101).

The food of Abramis brama in the Dzhezkazgan Reservoir in Kazakhstan contains 0.5% larvae of Trichoptera in winter, 7.3% in spring and 2.4% in summer (Malinovskaya, 1956:82). Several species of Cyprinidae in Lake Kurgal'dzhin feed on the following Trichoptera: Cyrnus flavidus Phryganea striata, Agrypnetes crassicornis, Oecetis intima. Trichoptera form 8.3% of the food of Carassius carassius, 17.8% of the food of C. auratus gibelio, 13.3% of the food of Leuciscus idus and 11.1% of the food of Rutilus rutilus; the percentage of Trichoptera in the food of the preceding fish decreases in summer in connection with the emergence of the spring generation of Trichoptera; the percentage rises again in autumn (Tyuten'kov, 1956:157–164).

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* These data apply to the large form of the whitefish which feeds in the littoral zone.

177 Large Cyprinidae such as Hemibarbus labia and H. maculatus feed in the Amur on the larvae of Hydropsyche, Aethaloptera rossica, Macronema radiatum, Amphipsyche proluta, various species of Psychomyiidae, Polycentropodidae, Phryganeidae and other families. Trichoptera are found by the hundreds in the stomachs of the aforementioned fishes (540—627 specimens); they form 23.9—39.4% of their diet on the average. In the Amur Trichoptera are eaten by Gobio ussuriensis, Chilogobio soldatovi and Sarcochilichtys sinensis lacustris; these small fishes have no economic importance but are the food of important predatory fishes. Gobio gobio also feeds on Trichoptera (Klyuchareva, 1952:371).

Trichoptera are part of the food of Bagridae in the Amur; 501—689 specimens were found in the stomach of Liocassis ussuriensis, forming on the average 40.5% of the food of this fish; 49.2% (sometimes 100%) of the food of Pseudobagrus fulvidraco consists of Trichoptera. Both species feed on larvae of Hydropsychidae (Hydropsyche nevae, Hydropsyche sp., Macronema radiatum, Aethaloptera rossica, Amphipsyche proluta), Polycentropodidae, Leptoceridae and Brachycentrus subnubilus. Small catfish also feed to a large extent on Trichoptera (Klyuchareva, 1952:371—380).

Many young predators feed on Trichoptera as accidental or supplementary food. When Perca fluviatilis, which is mainly a littoral fish, reaches a length of 4—8 cm, it begins to feed on Trichoptera; it also feeds on them later. Single specimens or small numbers of Trichoptera are swallowed by young Lucioperca lucioperca, Acerina cernua, young Esox lucius and Lota lota (Gadidae) (Shevchenya, 1940:103—115; Romanova, 1948:191, 193; 1949:29—30; Sal'dau, 1949:214—217). In Lake Kurgal'dzhin, the food of adult perch in spring contains 16.9% of Trichoptera; the summer diet of the fingerlings contains 20.1% of Trichoptera (Tyuten'kov, 1956:167).

Trichoptera are eaten by Anguilla anguilla, Cottus sibiricus, Nemachilus amudarjensis in the Aral Sea and N. stoliczkai; Trichoptera were found in the food of the Turkestan catfish Clyptosternum reticulatum (Nikol'skii, 1938:210, Figure 62). Agrypnetes crassicornis, Oecetis intima form part of the food of Abramis sapa, Pelecus cultratus, Rutilus rutilus and Lucioperca lucioperca in the Aral Sea (Pankratova, 1935:205—206).

Trichoptera are part of the food of domestic and wild aquatic birds or birds connected with water; Cinclus pallasii feeds on caddis flies together with other rheophilic insects; it gathers the larvae directly from the bottom of small brooks.

Terrestrial birds and some mammals feed on Trichoptera, especially when they fly in large numbers. For example, the white wagtail, the house martin and other birds feed their nestlings almost exclusively with caddis flies which appear on the shore of Lake Baikal in such large numbers that trees and stones are covered with them; at that time, Trichoptera are also eaten there by frogs, snakes, lizards and even bears, which collect the insects
178 from under upturned stones (Gusev, 1956). According to observations in the Kola Peninsula, adult Trichoptera are eaten by the hazel grouse, brambling, buntings, yellow wagtail, and goldcrest (Novikov, 1952:1166, 1179—1181, 1184). Starling, great tit, redwing, warblers and linnet feed their nestlings with

caddis fly larvae and other aquatic invertebrates; large larvae of Phryganea, Nemotaulius and Limnophilus are given to the nestlings together with their soft cases (Pokrovskaya and Gerd, 1955:96–99).

Fishermen widely use Trichoptera as bait; in some localities in the European USSR, caddis fly larvae are called "shitik," which is the name of ancient light boats, the boards of which were tied with bast or leather thongs. Adult Trichoptera are called "lipach" in the Lake Baikal region; they are used to catch graylings and lenoks.

The larvae of Limnophilus flavicornis and other species build their cases of large detritus particles and cover them with shells of small mollusks, often with the live mollusk inside; these species, therefore, may be beneficial as they help control the carrier of fasioliasis, Galba truncatula. Some caddis fly larvae build their cases entirely from mollusk shells. A larva of Limnophilus flavicornis may use as many as 70 live Galba truncatula for the covering of its case (Bednarz, 1958).

Trichoptera also cause damage. They shed their pupal exuviae during the nuptial flight; these exuviae float on the water and may clog the filters of municipal water pipes. For example, in Leiningrad in spring 1953, the filters were literally clogged with pupal exuviae of Hydropsyche nevae (E. E. Ruskina). Every year multitudes of this species hatch in the Neva River (near Petrokrepost'). They appeared in especially large numbers on 18–22 June 1952; they formed clouds in the town, entering through the windows, settling on food, and formed a thick layer on freshly painted walls and window frames, causing considerable economic damage (according to E. A. Migalina).

The building of reservoirs and hydroelectric stations provided new favorable habitats for rheophilic species of Hydropsychidae; they settle on the walls of canals, where they build their larval cases, nets and pupal shelters. The larval and pupal structures consist of solidly glued sand grains and small stones; they form incrustations which grow rapidly, narrowing the bed of the canal and often reducing the output of the power stations by 10–20% (Tsuda, 1957; Tsuda and Hiro, 1955).

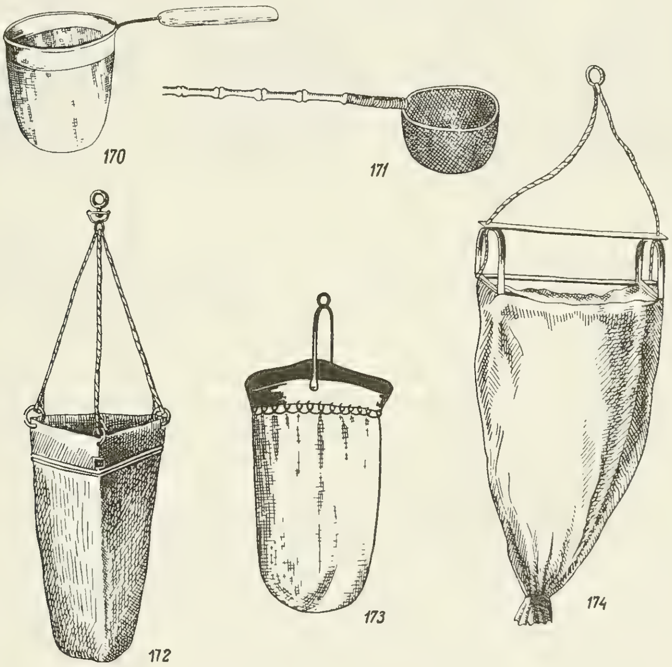
We recommend the following measures to prevent large-scale development of Trichoptera in canals: 1) periodic scraping of the canal walls; 2) facing the surface of the walls; 3) using electric current to prevent accumulation of larvae; 4) painting the walls with a paint containing cuprous oxide; 5) using insecticides. The most effective measure is the use of a paint containing cuprous oxide.

Multitudes of adult Trichoptera appear in Canada, on the banks of the Niagara River from near its source in Lake Erie and downstream for many tens of kilometers. The mass flight of Trichoptera was extremely intensive in August 1950; it began on the evening of 15 August and continued to
179 26 August. The swarms were so dense that over 6,800 specimens were caught with 10 strokes of a net. The predominant species was Hydropsyche bifida, which formed about 80% of the Trichoptera. The next numerous species were those of Cheumatopsyche, Neureclipsis crepuscularis, Macronema zebratum. The insecticide used for control was a 5% solution of DDT (Petersen, 1952; Munroe, 1951).

# METHODS OF COLLECTION, BREEDING AND CONSERVATION

Larvae and pupae of Trichoptera are collected by the usual methods for the study of the bottom fauna of stagnant or flowing water bodies; these methods have been described in "Zhizn' presnykh vod" (Life in Freshwater Bodies) and in other articles (Gerd, 1951; Zhadin, 1956, 1960). In the transparent water of springs, brooks, spring puddles or ponds, in the littoral zone of lakes and similar biotopes, caddis fly larvae are easily seen; they may be collected by hand, with a small net (Figure 170) or with a small metal sieve (Figure 171). Material from shallow water further from the shore is collected with a small dredge (Figure 172).

(180)



FIGURES 170–174. Collection tools:

170 – hand net; 171 – metal sieve; 172 – small triangular dredge; 173 – Dorogostaiskii's dredge; 174 – Sigsby trawl.

Examination of deeper water (0.5–1 m) has to be made blindly, with a hand net or scaper on a long rod. For greater depths, dredges, trawls or bottom samplers have to be used; caddis fly larvae do not live deeper than 10–12 m in large rivers, in the plains; and not deeper than 20–30 m in the sublittoral of lakes. Only isolated specimens or specimens carried from shallower parts are found at such depths. The samples are washed in a metal sieve with a mesh of about 1 mm$^2$.

A convenient dredge is the light portable dredge with a curved oval frame named Dorogostaiskii's dredge (Figure 173). This works well on stone, sand-stone or gravel bottoms of rivers or in the open littoral of lakes; it may be used on sand bottoms in the sublittoral zone of lakes. A convenient trawl is the small Sigsby trawl (Figure 174). Bottom-samplers (Echmann-Berge, Petersen and their modifications) are used for work on loose sand bottoms.

Examination of the fauna of stones is made with other instruments, e. g., Gerd's frame (Gerd, 1951:136; Zhadin, 1956:289). This is a square frame 180 (25 × 25 cm) of galvanized iron with 15 cm-high walls with pointed legs 5–10 cm high. If shallow water with a bottom of pebbles or small stones is examined, the frame is put on the bottom, and its legs are pushed into the sand or rubble under the stones; the stones are taken from the frame; the animals floating or falling from the stones are collected with a small net about 15 cm wide. Caddis fly larvae usually cling to the stones; The specimens are then counted and weighed; the number of specimens and their biomass are related to the bottom surface covered by the frame; these figures are usually calculated for 1 $m^2$. The caddis fly population of stony water bottoms is often dense; for example, in some biotopes in Lake Onega, there were up to 289 specimens per $m^2$ with a biomass of 3.1 $g/m^2$ (a biomass of 31 kg/hectare).

181 Work in mountain brooks with a bottom covered with boulders and pebbles and with a rapid current (1.8–2 m/sec) is done with Sadovskii's benthometer; this functions in the current (Sadovskii, 1948:366, Figures A–C; Zhadin, 1956:290). It consists of a metal cylinder open at top and bottom 75 cm high, with a serrated lower margin and 2 handles at the upper margin; at 1 side of the cylinder there is a square "window" covered with a metal screen (38 × 38 cm); on the other side is an opening of the same size, to which a metal frame with a canvas bag is connected. The benthometer is used as follows: it is pressed into the bottom; the pebbles and gravel in the benthometer are stirred through the open upper part; the stones are then taken out and the organisms washed from them are carried by current into the canvas bag; they are then counted. If quantitative collections of caddis flies are made, the larvae are taken from the cases and dried with filter paper; after the material has been weighed, the case is put back on the larvae if they are to be preserved. The larvae are preserved in their cases, which are an important character of the species; it is often impossible to identify the larvae without the case. Quantitative methods are recommended, as Trichoptera are an important part of the food of fish.

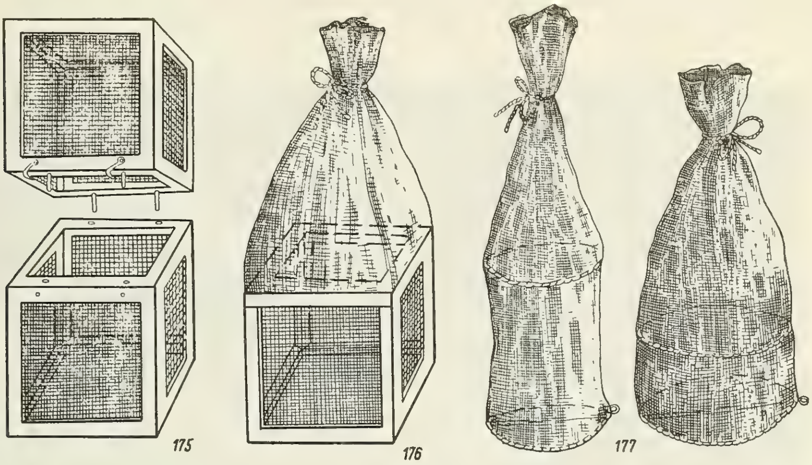
Larvae and pupae should be preserved in 80–90° alcohol; this has to be changed if it becomes yellow or green from the plant particles of the case. Egg masses of caddis flies should be placed in 4% formaldehyde in which they preserve their form, and to some extent, their color; the egg masses shrink rapidly and lose their form in alcohol.

Not all larvae and pupae of Trichoptera in the USSR are known, and collection of all stages of the larvae is, therefore, valuable.

In order to identify the species of a new larva some specimens should be kept alive until they pupate; it is then possible to identify the adults hatching from the pupae.

Caddis fly larvae in stagnant water live well and complete their development in an aquarium with sufficient food and oxygen. After the

182 larvae have pupated, a plant stalk or rod is placed in the water to enable the pupa to emerge; the aquarium should be covered with a net.



FIGURES 175–177. Breeding cages:

175 – breeding cages with metal screen; 176 – breeding cages with a metal and fabric screen; 177 – various types of breeding cages (175 – according to Lepneva, 176 and 177 – according to Zhil'tsova and Chistyakova).

Some Trichoptera of flowing water may also live in such aquaria; however, they need a lower and more constant temperature, and have to be kept in a cool place. The larvae of Trichoptera living in cold rapid streams do not survive in ordinary aquaria; special breeding cages placed in their natural environment are used for observations of these species and for breeding adults (Lepneva, 1927; Zhil'tsova and Chistyakova, 1956). The breeding cages (Figure 175) are boxes consisting of 2 halves, the walls of which are made of metal screen on a wooden frame. For small species (Hydroptilidae, Agapetinae) the mesh of the screen should be 0.2–0.3 mm; for larger larvae a mesh of 1–1.5 mm may be used. The breeding cages may be made of bolting silk or gauze (Figures 176, 177); however, gauze rapidly wears off and has to be changed frequently. An artificial bottom is prepared in the cage, which resembles the natural conditions of the larva; if predators are bred, small aquatic animals are placed in the cage. The
183 cage is placed in a creek (Figure 178); it should be hidden among stones or shrubs. The top of the cage should be outside the water so that the pupa can crawl out and the adults hatch; the cages should be examined daily.

The breeding-cages or aquaria are very convenient when full-grown larvae or pupae are found which are ready to hatch. Some of the material is fixed, some is taken alive to the laboratory for observation and for breeding, another is placed in breeding cages at the site of collection.

Rheophilic caddis flies should be kept in aquaria with a water current; such aquaria have been described (Murphy, 1919; Brickenstein, 1955, Figure 1; Sattler, 1958:120–122, Figure 2; Kazlauskas, 1960, Figure 1).

The current is made by an air jet; this is convenient as the current has a definite direction; it is weaker in some places so that there are parts with a current of varying speed; this enables the insects to select places with a favorable current. Sattler (ibid.) made his observations on the larvae of Hydropsyche in such aquaria (Figure 179).

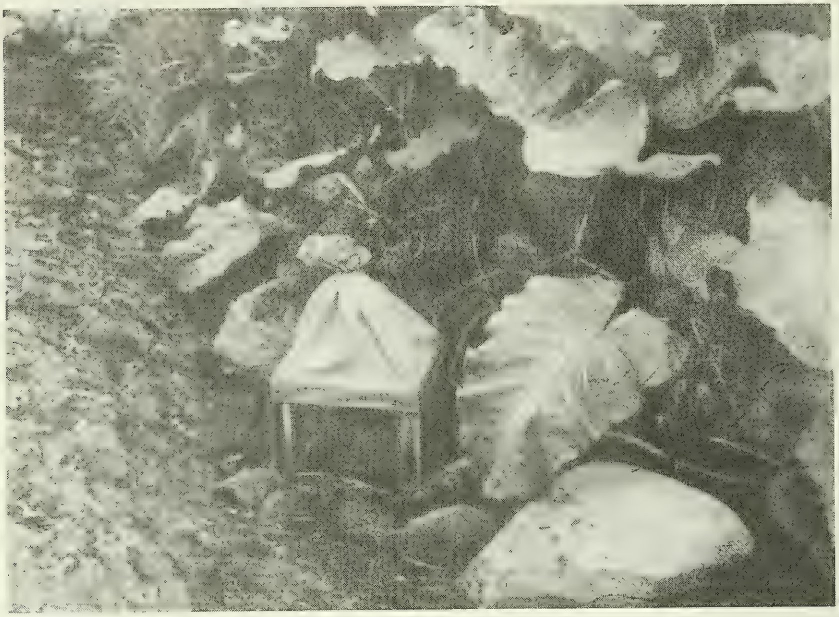
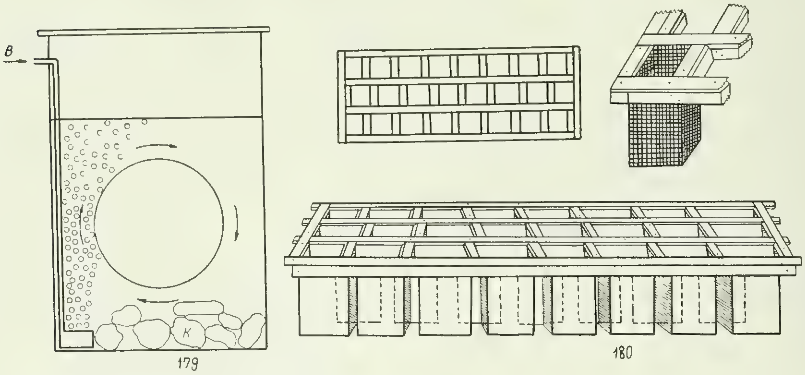


FIGURE 178. A breeding cage in a brook



FIGURES 179–180. Flowing-water breeding cages:

179 – aquarium of Sattler; the small circles represent air bubbles; the arrows indicate the direction of the current; k – stones; 180 – serial breeding cages of Wiggins (after Wiggins).

A convenient device for breeding rheophilic caddis fly larvae is the running-water tray of Frantsev. His description is as follows: "The model 184 consists of 2 parallel oval trays, 3 m long. The trays are made of vinyl;

a pane of glass is placed into a 50-cm part of one of the walls, for observation. The wheels are made of vinyl and their axis is a glass rod; the current is created by 8-vaned wheels with a small motor. These wheels are preferable to propellers as they create a uniform current. Each tray contains 30 liters of water (Frantsev, 1961:324–325, Figure 1).

Wiggins described breeding cages of aluminum screen, covered with glass; these cages are placed in wooden frames; the frame is placed on a tray with running water; the frame may be placed in the river; only its lower half should be in the water (Figure 180). Breeding cages may also be used in stagnant water such as ponds and calm parts of lakes; the buoyancy of the frame and the immersion of the breeding cages to the necessary level should be ensured (Wiggins, 1959). Food and twigs for the pupae to emerge should be placed in the cages.

The serial breeding cages make simultaneous observations on several species possible; one larva can be placed in each cage; several pupae can be placed in a cage if it is sure that they belong to the same species.

Full-grown larvae are identified with a binocular microscope; the mandibles of the larva should be separated. For the examination of smaller structures, the larva has to be dissected and examined under the microscope; this is necessary for the study of the mouthparts, the chaetotaxy and the anal legs.

To identify small species, and for morphological studies, microscopic preparations are made on 3 slides in the following order: 1) dorsal view of head, ventral view of head (the maxillolabium is not separated), dorsal view of labrum, dorsal view of right and left mandible; 2) dorsal and ventral thoracic sclerites; sclerite of segment 9; outer view of right anal leg, inner view of left anal leg; 3) legs: left column: legs 1–3, posterior view; right column: legs 1–3, anterior view. The preparations are usually made in Faure's gum medium; permanent preparations are mounted in Canada balsam. The sclerites can be separated from the muscles by dissection under the binocular. The larva may be treated with KOH.

The 1st and 2nd stages of the larvae are often almost transparent and can be examined directly under the microscope.

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(Compiled by S. G. Lepneva and E. A. Temyueva)

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## The population of water bodies and its economic importance

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## 205 SYSTEMATIC PART

### ORDER TRICHOPTERA

**Full-grown larva.** Length 2.5—40—45 mm. Body elongate, divided into head, thorax and abdomen, slightly dorsoventrally flattened or cylindrical. Head prognathous or hypognathous; antennae rudimentary; eyes small. Mouthparts well developed: mandibles of biting or cutting type; opening of spinning glands at the end of the labium. Pronotum, and sometimes also meso- and metanotum, completely sclerotized or meso- and metanotum membranous or partly sclerotized.

Legs of walking type; forelegs of many species raptorial; hind legs sometimes natatorial.

Abdomen with 9 segments, boundaries between them always well marked; constrictions sometimes deep; 1st segment shorter than the others, with a dorsal and lateral tubercle in some forms; segment 9 with 2 anal legs with claws. Tracheal gills present on abdomen, rarely on thorax and abdomen; some families have no gills.

The larvae build tunnel-shaped tubes, capturing nets or portable cases of various forms with a covering of plant or mineral particles.

**Pupa** free. Head with large, faceted eyes and long antennae, which are sometimes curled around the body's posterior end. Labrum flat, with thick, vertical setae; mandibles thick, cutting, with teeth or serrated on the inner side; maxillary and labial palps resembling those of the adult.

Mesothorax is the largest thoracic segment, prothorax the smallest; the wing sheaths envelop the body laterally and ventrally.

Legs long; tarsus 5-segmented, as in the adult; the terminal (6th) segment bears 2 small, weakly sclerotized terminal claws; midlegs natatorial, with dense setae on the tarsi.

Abdomen spindle-shaped, longer and thicker than in adult; dorsum of segments 3—6 or 3—8 with small sclerites covered with spinules.

The anal appendages form rods or lobes with thick setae in most forms. Ventral processes contain the developing genitalia.

Pupae situated in cavelike, shield-shaped cases or in cases resembling larval cases which are sac-shaped or tubular; pupal cases are attached to the bottom or rarely lie free on the bottom.

Mode of life and habitats. Benthic organisms; living on the bottom rarely on algae; larvae microphagous, algophagous, phytophagous, detritophagous and rarely predaceous. They live in fresh, running or stagnant water, some forms in brackish water.

Distribution. Cosmopolitan.

Key to Suborders

Full-grown larva

1 (2). Larvae campodeiform; head prognathous. Dorsal and lateral tubercles of abdominal segment 1 absent. Numerous genera without tracheal gills; if present, gills are situated either on the thorax, or on the abdomen, or on thorax and abdomen, laterally and ventrally; if they have a different arrangement, the forms are small and gills are present only on the last abdominal segment. Anal legs usually long, with downward-directed claws. Larvae either without case or if they live in cases, they are not tubular . . . . . . . . . . . . . . . . . . . . . . . . **I. Annulipalpia** Martynov (p. 211)

206 2 (1). Larvae eruciform or suberuciform; head hypognathous or nearly hypognathous. Dorsal and lateral tubercles of abdominal segment 1 and tracheal gills present (with rare exceptions); gills present only on abdomen, on the dorsal, lateral and ventral side of segments. Anal legs short, with laterally-directed claws. Larvae live in cases which are cylindrical, conical, trihedral or tetrahedral tubes with a covering of mineral or plant particles . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **II. Integripalpia** Martynov

Pupa

1 (2). Abdominal segment 1 without dorsal tubercles. Anal appendages lobe-shaped; if oblong, they are not very thin; they are sometimes absent. Pupae situated in cavelike cases of mineral (rarely vegetable) particles with an open ventral side attached to the substrate; if in closed cases, pupae are small (3–5 mm), of varying form, consisting of secretion and sand grains; tubular cases have smooth walls of sand grains only in the Macronematinae, which are large species in the rivers in the Far East, and East and South Siberia . . . . . . . . . . . . . . . . . . **I. Annulipalpia** Martynov (p. 211)

2 (1). Abdominal segment with a dorsal tubercle with denticles or spines. Anal appendages usually thin, rodlike or lobe-shaped, short and pointed. Pupae in tubular cases resembling the larval cases; their end covered with a membrane with 1 or several rounded, slitlike or irregular openings . . . **II. Integripalpia** Martynov

## I. Suborder ANNULIPALPIA Martynov

**Full-grown larva.** Larvae campodeiform, 2.5–40 mm long; head prognathous; abdomen of most forms long, more or less dorsoventrally compressed, sometimes laterally compressed; constrictions between abdominal segments deep; gills (if present) situated in the pleural and ventral region of the body; isolated dorsal gills or gills on claws present only on the 9th abdominal segment of Hydroptilidae. Anal legs usually long, with a downward-directed claw. Most species live free, without case; among them are many predators which build capturing nets; when larvae live in cases, the cases are not tubular.

**Pupa.** The pupa is of varying size and form, 2.2—35 mm long. Abdominal segment 1 without dorsal tubercle; gills present only in the 3 highest families. Anal appendages usually lobe-shaped, short, rounded or notched at the end; if the anal lobes are long, they are not very narrow and rodlike; anal appendages sometimes absent. Pupae live in cavelike cases with a covering of small stones or sand grains, attached to substrate with the margin of the open ventral side, or in very small (3—5 mm) flattened or differently shaped cases consisting of secretion or secretion-covered with small sand grains attached to the substrate by ligaments which are widened at the end; tubular cases of the Macronematinae in the Far East and Siberia are irregular, oblong-cup-shaped, smooth walls covered with small sand grains; they are attached to the substrate at the narrow anterior end.

Mode of life and habitats. Live in running water, in various types of streams, from springs and small brooks to turbulent mountain streams and large rivers in the plains; a few species live in stagnant water, mainly in large, clean water bodies.

Distribution. Cosmopolitan.

### Key to Families

Full-grown larva

1 (12). Large secondary setae absent on the legs; there is no dense row of long, thin setae on the sides of the abdomen; there is also no cover of minute setae on the body; meso- and metanotum membranous; if sclerotized, the larvae are small and live in cases . . . . . . . . . . . . . . I. Superfamily **Paleochaetoidea** Lepn. (p. 214)

207 2 (3). Larvae small, 2.5—5.5 mm long; dorsum of all 3 thoracic segments sclerotized; abdomen broader and higher than head and thorax, laterally compressed in most forms; tracheal gills, if present, only on abdominal segment 9 and at base of claws of the anal legs. Case of varying form, made of secretion, secretion and algae, secretion and small mineral particles; they are usually laterally or dorsoventrally flattened . . . . . . . . **III. Hydroptilidae** Steph. (p. 345)

3 (2). Larvae usually larger; pronotum sclerotized; meso- and metanotum membranous; abdomen often more or less flattened dorsoventrally; gills, if present, only on abdominal segment 8; tracheal gills on segment 9 absent. Larvae without case; if they live in cases, the species are medium sized or small, the case is flat ventrally, roof-shaped dorsally, consisting of small stones or large sand grains.

4 (7). Larvae large, medium sized or small; dorsal sclerite of abdominal segment 9 present; tracheal gills present or absent; larvae with or without case.

5 (6). Larvae large or medium sized; body of many forms dorsoventrally flattened; tracheal gills present or absent; case absent . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **I. Rhyacophilidae** Steph. (p. 215)

6 (5). Larvae medium sized or small; tracheal gills absent; larvae with shieldlike cases . . . . . . . . . . **II. Glossosomatidae** Wall. (p. 322)

7 (4). Larvae of a different form, large or medium sized; tracheal gills absent; abdominal segment 9 without dorsal sclerite; case absent.

8 (9). Dorsal side of labrum membranous and movable in its greater part, with broad, straight, anterior margin and narrow, posterior margin; a small sclerite at the base of the labrum . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **IV. Philopotamidae** Steph. (p. 408)

9 (8). Labrum sclerotized dorsally.

10 (11). Larvae larger, to 40 mm long; head and pronotum oblong; narrow labium has an ordinary structure, with small palps; sclerites have a distinct, dark punctate pattern . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **V. Stenopsychidae** Mart. (p. 423)

11 (10). Larvae medium sized; head almost as long as broad; labium prolonged in a narrow ligula; labial palps absent . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **VI. Psychomyiidae** Kol. (p. 440)

12 (1). All segments of the legs or only the coxae with usually numerous, large secondary setae; sides of the abdomen with a longitudinal row of thin, light setae; if this row is absent, abdominal segments are densely covered with small, dark chetoids; meso- and metanotum sclerotized; if they are membranous, the anal legs are very long, with a large number of long, strong setae . . . . . . . . . . . . . . . . . . . . . . . . . . . . . II. Superfamily **Neochaetoidea** Lepn. (p. 465)

13 (14). Only pronotum sclerotized; anal legs very long . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **VIII. Polycentropodidae** Ulm. (p. 472)

14 (13). Nota of all 3 thoracic segments sclerotized; anal legs shorter.

15 (16). Secondary setae of legs present only on coxae; tracheal gills absent . . . . . . . . . . . . . . . . . . . . **VII. Ecnomidae** Ulm. (p. 465)

16 (15). All leg segments with numerous secondary setae; tracheal gills numerous.

17 (18). Frontoclypeus with distinct lateral notches; gula extending to occipital foramen; meso- and metanotum with a transverse suture . . . . . . . . . . . . . . . . . . . . . . . . . . **IX. Arctopsychidae** Mart. (p. 528)

18 (17). Frontoclypeus without lateral notches or lateral notches little marked; gula small, triangular; meso- and metanotum complete, without suture . . . . . . . . . . . . . . **X. Hydropsychidae** Curt. (p. 543)

Pupa

1 (12). Tracheal gills absent; anal appendages absent or very small and narrow, with 2–7 setae; if there are more setae (29–30) the appendages are short and cylindrical; pupae large (26–30 mm), with long antennae curled around the posterior end of the body . . . . . . . . . . . . . . . . . . . . . I. Superfamily **Paleochaetoidea** Lepn. (p. 214)

2 (3). Pupae small (2.2–5.0 mm); wing sheaths narrow, pointed, extending to body's end or slightly beyond it; cases sac-shaped, of various form, usually more or less flattened laterally or dorsoventrally, consisting of secretion with a covering of algae or fine sand grains . . . . . . . . . . . . . . . . . . . . . . . . . . **III. Hydroptilidae** Steph. (p. 345)

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3 (2). Pupae large, medium sized or small; cases cavelike, rarely (Macronematinae) irregularly tubular.

4 (7). Pupae situated in a thick, shining brown cocoon with elastic walls filled with fluid; cocoon is attached to the walls of the case at anterior and posterior ends; case has strong walls consisting of small stones and large sand grains with an open ventral surface; margin of the case attached to the substrate.

5 (6). Pupae 10—20 mm long, rarely less than 8—10 mm long; seta 1 of labrum not shorter than the others; number of spurs on legs, 3, 4, 4; case 12—30 mm long . . . . . . . . **I. Rhyacophilidae** Steph. (p. 215)

6 (5). Pupae 3.5—8.0 mm long; seta 1 of labrum markedly smaller than the other 5; number of spurs on legs 2, 4, 4; case 5—10 mm long . . . . . . . . . . . . . . . . . . . . . . . **II. Glossosomatidae** Wall. (p. 322)

7 (4). Cocoon consisting of gray, loosely woven tissue; case of different appearance; if it has the same appearance, it is large.

8 (11). Mandibles massive, cutting; blades of mandibles with several large teeth or serrated.

9 (10). Pupae medium sized (to 18 mm long); mandibles geniculate at base, with several large teeth distally; case woven of loose tissue with a covering of sand grains or small stones . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **IV. Philopotamidae** Steph. (p. 408)

10 (9). Pupae large, to 30 mm long; blade of mandibles serrated, without denticles; case large, elliptical; walls strong, consisting of large and small stones . . . . . . . . . . . **V. Stenopsychidae** Mart. (p. 423)

11 (8). Mandibles prolonged into a thin, long, filiform process, curved at the end . . . . . . . . . . . . . . . . . . **VI. Psychomyiidae** Kol. (p. 440)

12 (1). Tracheal gills present except in 1 family; anal appendages with numerous setae, rounded, lobe-shaped or in form of short, thick rods . . . . . . . . . . II. Superfamily **Neochaetoidea** Lepn. (p. 465)

13 (14). Mandibles with straight, pointed distal part, without teeth; tracheal gills absent; anal appendages small, rounded; their setae are not as numerous as in the following families . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **VII. Ecnomidae** Ulm. (p. 465)

14 (13). Mandibles sickle-shaped, without teeth, or of a different form, with large and strong teeth in the distal part; tracheal gills present.

15 (16). Mandibles narrow, sickle-shaped, without teeth, with 2 outer setae at the base; tracheal gills with 2 filaments; anal processes short, lobe-shaped, with numerous setae posteriorly . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **VIII. Polycentropodidae** Ulm. (p. 472)

16 (15). Mandibles massive, with large teeth on blades; outer setae primary and secondary; tracheal gills in form of a small rod with 5—30 filaments; anal appendages forming long lobes or broad rods with short, strong setae along their whole length.

17 (18). Gills in form of a short cylindrical stalk with apical filaments . . . . . . . . . . . . . . . . . . . . . . . . . . . **IX. Arctopsychidae** Mart. (p. 528)

18 (17). Gills in form of a long rodlike stalk with filaments their whole length . . . . . . . . . . . . . . . . . **X. Hydropsychidae** Curt. (p. 543)

## I. Superfamily PALEOCHAETOIDEA Lepneva

**Full-grown larva.** Length 2.5—40.0 mm. Primary chaetotaxy predominant. Secondary chaetotaxy little developed, mainly on the pronotum; sclerite "b" of the anal legs without secondary setae or with only a few secondary setae.

**Pupa.** Length 2.2–30.0 mm. Tracheal gills absent; anal appendages absent; if present, they are narrow, with few setae (5–7) or (Stenopsychidae) short and cylindrical, rounded apically, with 29–31 short setae; the pupa is large in this case, with long antennae curled around the posterior end of the body.

Mode of life and habitats. Microphagous, algophagous, rarely (Rhyacophilidae) predaceous.

Distribution. Cosmopolitan.

## I. Family RHYACOPHILIDAE Stephens

**Full-grown larva.** Larvae vary in size and morphology. Length 8.5–30.0 mm. Mandibles without teeth or with a few large teeth. Pronotum sclerotized; meso- and metanotum membranous. Abdomen more or less 209 dorsoventrally flattened or almost cylindrical in the middle; gills often absent; if present, they are of varying form.

Dorsal sclerite of segment 9 relatively large. Section "a" of anal legs absent; sclerites "b" and sometimes also sclerites "c" of some forms have long processes.

Larvae without case.

**Pupa.** Length of pupa 8–20 mm. Labrum short, rounded laterally. Mandibles slightly curved, with 2–3 large or small teeth. Midlegs strong, natatorial, with a row of dense setae on tarsal segments; claws of all legs large, hook-shaped. Anal appendages absent. The pupae are situated in closed, thick, elastic and fluid-filled cocoons which are weakly attached anteriorly and posteriorly to the cavelike case, which is oblong, dome-shaped; it consists of small stones or large sand grains which are connected with strands of tissue; they are attached to the substrate at the margin of the case; there are numerous small openings between the stones through the case wall which ensure a rapid flow of water in the case.

Mode of life and habitats. The species of the family predominate in small cold or cool brooks and rivulets, from the snowline in the mountains to the plains, where they are usually restricted to hilly landscapes and spring regions; they also live in large turbulent mountain streams; they avoid large rivers in the plains and slowly flowing rivers and rivulets overgrown with plants.

Distribution. Throughout the USSR, mainly in mountainous regions. They also occur in Europe, Asia, America and Australia.

### Key to Subfamilies

### Full-grown larva

1 (2). Frontoclypeus of characteristic form, with deep lateral notches in the region of the tentorial pits; the forelegs differ little from the mid- and hind legs in size and form; claws are normally developed; gills sometimes present. Widely distributed in the USSR . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Rhyacophilinae Ulm.**

2 (1). Frontoclypeus irregularly oblong-triangular; forelegs characteristically specialized, markedly different from mid- and hind legs; claws very long. Distributed in Middle Asia and in the south of the Ussuri Territory; rare . . . . . . . . . **2. Hydrobiosinae** Ulm. (p. 316)

Pupa*

1 (2). Length 8–20 mm; case consisting of small stones or large sand grains; cocoon thick, reddish brown; common throughout the USSR . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **1. Rhyacophilinae** Ulm.

2 (1). Pupae at most 7–8 mm long. Case consisting of sand grains or small stones; pupa situated in a yellowish brown transparent cocoon; rare . . . . . . . . . . . . . . . . . . . . . **2. Hydrobiosinae** Ulm. (p. 316)

## 1. Subfamily RHYACOPHILINAE Ulmer

**Full-grown larva.** Length 12–30 mm. Head more or less flattened, with uniformly developed dorsal and ventral surface in most forms; frontoclypeus with deep lateral notches in about the middle of the sclerite; tentorial pits distinct and dark at bend of frontal sutures. Gula triangular, pregula broad, sometimes in form of a trapezoidal sclerite. Eyes situated close to anterior margin of the head; antennae situated at margin of the gnathal opening, between articulation of the mandibles. Labrum with rounded anterior angles; dorsal sclerite with a wide median notch anteriorly; setae, except seta 1, are situated at or near the sclerite margin. Submentum forming a short, broad sclerite which is usually narrower and shorter than the pregula.

Pronotum with a broad, dark border posteriorly; secondary setae few in number; meso- and metanotum membranous; secondary setae absent except for a small seta at the anterior angle which is constant in this order; they are also absent on the abdominal segments.

210 Setae of legs also only primary; trochanters and femora ventrally with a narrow membranous stripe. Gills, if present, situated at base of mid- and hind legs and in pleural region of abdominal segments. Dorsal sclerite of segment 9 broadly dark at anterior margin; its posterior margin notched in the middle, with 4 lateral setae. Six anal gills; anal legs of different structure in the different genera and groups of species; they usually have a basal ventral hook on sclerite "b"; they sometimes have a long process on sclerite "b" or "c"; the claw is with or without ventral spinules. Primary setae may be very long or very short, slightly dark. Larvae live free, without case. The species of the subfamily are predatory.

**Pupa.** Length 11–22 mm. Antennae extending in male pupae to 7th or 8th abdominal segment; in female pupae, to middle of 5th segment; basal segment larger than others, usually with 3 setae. Labrum with 5 setae. Mandibles asymmetrical; left mandible with 2 teeth; right mandible with 3 teeth; anterior (dorsal) seta of mandibles curved and smaller than

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* Pupae of Hydrobiosinae have not been found in the USSR; the pupal cases examined contained a larva (prepupa); provisional identification is given on the basis of the case, cocoon and size of the pupa.

posterior seta. Natatorial setae of midlegs are dense, well developed. Claws of legs well developed, hook-shaped, a soft cylindrical process between them. Sclerites of the raptatorial apparatus are brown and convex; presegmental plates on segments 4—7; postsegmental plates on segments 3—5; spinules small, straight and numerous. Gills absent in the larvae even in species with gills. End of body of female pupa blunt; end of body of male pupa with rudiments of the developing genitalia.

Case 15—30 mm long, consists of small stones or sand grains; its upper surface not smooth; ventral surface of case open; margin of case attached to the substrate by numerous disks which sometimes have short stems; numerous openings through wall of case between the small stones or sand grains. The pupa is situated in a semitransparent, dark brown cocoon.

The subfamily Rhyacophilinae Ulm. was established by Ulmer (1903: 124—126; 1907:206—207) with the genus Rhyacophila Pict.; Banks (1940) separated from Rhyacophila the Asian genus Himalopsyche Banks, which contains large species; Lepneva (1956) described the new genus Philocrena Lepn. from a larva from Transcaucasia; this genus is represented in Transcaucasia by one rare, high-mountain, relict species.

Mode of life and habitats. Living in rapidly running brooks and rivulets with a usually stony bottom.

Distribution. Throughout the USSR and also in Europe, Asia and America.

## Key to Genera

### Full-grown larva

1 (2). Gular suture markedly longer than gula; second segment of maxillary palps markedly longer than the other segments. Pronotum relatively smooth, without sculpture and without longitudinal row of setae parallel to the median suture; gills, if present, of varying form; anal legs normally developed; sclerite "b" sometimes with a lateral process. Widely distributed throughout the USSR . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **1. Rhyacophila** Pict. (p. 217)

2 (1). Gular suture not so long; second segment of maxillary palps not longer than the other; pronotum of different structure; gills, if present, in the form of a comb of filaments on a narrow, conical, lateral process of the segment; anal legs of different structure. Rare.

3 (4). Body markedly flattened; pronotum with a longitudinal row consisting of one primary seta and several thinner secondary setae on both sides of the median suture; tracheal gills in the form of a comb of filaments on a long, narrow, conical process; anal legs relatively short; sclerite "c" sometimes with a long process which is forked at the end. Middle Asia . . . . . . . . **2. Himalopsyche** Banks (p. 298)

4 (3). Body nearly cylindrical; pronotum oblong, with a sculpture consisting of ridgelike and tuberculate processes; sides of meso-, metathorax and first abdominal segment with rounded tubercles; tracheal gills absent; anal legs very large, and the claws are unusually long. Transcaucasia . . . . . . . . . . . . . . . . . **3. Philocrena** Lepn. (p. 308)

### 1. Genus Rhyacophila Pictet.

**Full-grown larva.** Length 10–24 mm. Head usually more or less oblong; body slightly flattened or almost cylindrical. Pronotum with smooth surface and a few secondary setae; forelegs slightly different from the
211 mid- and hind legs in size and form of the segments; anterior-angle and medioanal setae of mesothorax, metathorax and abdominal segments well developed; in primitive forms (as in the early stages), are long; they are short and small in the higher forms. The anal legs have a long sword-shaped process on sclerite "b" or, as in the young larvae of the whole genus, such a process is absent.

This is a large and complex genus; Döhler (1950:272–276) divided the European species of the genus according to the larvae into 6 subgenera which have also been recorded from the USSR (except one subgenus). As only a small number of species of the genus is covered by Döhler's classification, we consider them as groups of species. Another two groups of species were established in the USSR from material from the Asian part of the Soviet Union.

Mode of life and habitats. Brooks and rivulets with a rapid current, on a solid (usually stony) bottom; predatory, with a few exceptions.

Distribution. Throughout the USSR and also in Europe, Asia and North America. This genus occurs rarely also in North Africa.

### Key to Groups of Species*

Full-grown larva

1 (8). Sclerite "b" of anal legs with a long sword-shaped process posteriorly.
2 (5). Tracheal gills with numerous filaments.
3 (4). Gills forming a tuft, with a short stalk and numerous filaments . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Rhyacophila** s. str. Döhl. (p. 219)
4 (3). Gills conical, with a long stalk and filaments situated on one side . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Hyperrhyacophila** Döhl. (p. 239)
5 (2). Gills with four filaments, or one filament, or gills absent.
6 (7). Gill with four segmented filaments . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. **Pararhyacophila** Döhl. (p. 242)
7 (6). Gills with a single filament or absent . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4. **Mesorhyacophila** Lepn. (p. 248)
8 (1). Sclerite "b" without sword-shaped process.
9 (10). Gills forming a tuft . . . . . . . . 5. **Paleorhyacophila** Lepn. (p. 262)
10 (9). Gills with a single filament or absent.
11 (12). Gills with a single filament . . . 6. **Prosrhyacophila** Döhl. (p. 265)
12 (11). Gills absent . . . . . . . . . . . . . 7. **Hyporhyacophila** Döhl. (p. 275)

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* In the classification of the subgenera of Rhyacophila, Döhler (1950:272) considered the presence of 2 or 3 anterior-angle setae on the pronotum as one of the principal characters. We are not using this character, because the number of anterior-angle setae in the notch of the pronotum is always 3 in Rhyacophila: one primary and 2 secondary setae. One of the secondary setae may be almost as long and dark as the primary seta, while the 2nd secondary seta is small, or both secondary setae are long but not always as long as the primary seta.

## 1. Group Rhyacophila s. str. Döhler

Döhler, 1950:272.

**Full-grown larva.** Length 22—24 mm. Head oblong; setae described under Rhyacophila septentrionis. Mandibles without apical teeth; a small basal tooth only on the right mandible. Submentum with slightly concave anterior margin and convex posterior margin; posterior angles uniformly rounded; setae situated near the anterior angles; mentum with a narrow median suture; maxillary palps thicker than galea; 2nd segment markedly longer than the others. Pronotum with 2 long setae (a primary and a secondary) in the depression at the anterior angle; 3rd seta (2nd secondary seta) small and indistinct between the long setae. Tracheal gills present on mesonotum, metanotum and abdominal segments 1—8; they consist of a short branched stalk and filaments. Posterior margin of dorsal sclerite of segment 9 with a shallow, median notch lateral to which stands a long medioanal and anterior-angle seta and short, thin intermediate and lateral setae between the above setae. Sclerite "b" of the anal legs with a large pointed sword-shaped process; distodorsal tubercles blunt and high; the basal of the 3 dorsal primary setae is long; the distal part bears a short, thin seta and a long, thick seta. The claw has equally developed basal and distal parts; the distal part bears 2 or 3 ventral spinules; setae 1, 3 and 5 are longer than the others; seta 2 is shorter; seta 8 is situated on a short, blunt spinelike process.

## 212 Key to Species

Full-grown larva

1 (8). Posterior margin of pronotum black.
2 (7). Head and pronotum light brown, with a distinct dark pattern. Dorsal stripes on head dark brown, broad; they are darker in the anterior part; they extend to near the coronal suture in the posterior part; they are divided along the median suture by a narrow, light stripe; the space between the dorsal and lateral stripes is slightly or distinctly dark, with large light, round spots at the base of the setae; the gill filaments are normally developed.
3 (4). Dorsal stripes of head dark brown, wide, darker anteriorly. The space between the stripes is markedly lighter than the stripes; ventral surface without dark dots ........................................... **1. Rh. septentrionis** McL. (p. 220)
4 (3). Head of uniform width anteriorly and in the middle; its sides are almost parallel in dorsal view; the space between the stripes is slightly dark; ventral dots dark, numerous or absent, rarely distinct.
5 (6). Frontoclypeus light anteriorly; the space between the stripes is markedly dark; dorsal and lateral stripes almost fused in dark specimens; ventral dots absent or indistinct; mainly distributed in northern and Central Europe ..... **2. Rh. obliterata** McL. (p. 227)
6 (5). Frontoclypeus dark not only in the posterior part but also near the anterior margin; space between stripes distinct, slightly dark; large dots on the ventral side, usually on a dark background; Caucasus ................. **8. Rh. subovata** Mart. (p. 236)

7 (2). Larva light; head and pronotum yellowish; dorsal and lateral stripes slightly dark, dots dark; space between dorsal and lateral stripes almost as yellow as the anterior part of the head; gill filaments thin and long . . . . . . . . . . . . . . **3. Rh. cupressorum** Mart. (p. 227)

8 (1). Posterior margin of each half of the pronotum with a broad, distinct, brown, complete or incomplete transverse stripe.

9 (14). Dorsal stripes of head short, broad, almost completely fused with the lateral stripes; posterior part of the pronotum with a large, dark, broad spot.

10 (13). Dorsal stripes on head widely separated in the middle.

11 (12). Posterior margin of sclerite of segment 9 light in the middle, with narrow dark stripes laterally . . . . . . . . **4. Rh. nubila** Zett. (p. 231)

12 (11). Posterior margin of segment 9 with a continuous dark brown margin; no interruption in the middle of the posterior margin . . . . . . . . . . . . . . . . . . . . . . . . . . . . **5. Rh. subnubila** Mart. (p. 233)

13 (10). Dorsal stripes of head situated close together in the middle; a narrow light stripe along the coronal suture . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **6. Rh. dorsalis** Curt. (p. 234)

14 (9). Space between dorsal and lateral stripes distinct, light or hardly noticeable; broad dark spot in posterior part of pronotum absent; rows of dots in posterior part of pronotum on a light or slightly dark background . . . . . . . . . . . . . . **7. Rh. vulgaris** Pict. (p. 235)

### 1. **Rhyacophila septentrionis** McLachlan

Klapálek, 1893:126—128. — Struck, 1903:79, Plate IV, Figure 4. — Ulmer, 1903:127—128, Figures 11, 22, 36, 46, 72, 83, 108; 1909:220, Figure 344, b. — Siltala, 1905:146—148, Figure 39. — Lestage, 1921:415—417, 419, Figure 134, b, j, k. — Nielsen, 1942:337—358, Figures 10—22. — Hickin, 1954:59—61. — Mackereth, 1954:150—151, Figures 1, s; 3, s.

**Full-grown larva** (5th stage), Length at end of 5th stage 23.0—23.4 mm. Sclerites light brown or reddish yellow; pattern brown or dark brown. Head (Figures 181, 182) oblong, dorsoventrally compressed; eyes situated dorsolaterally, near the anterior margin; antennae situated anterior to eyes, near the dorsal articulation of the mandibles. A dark heart-shaped spot in the posterior part of the frontoclypeus which does not reach the angle of the frontal sutures and bears light dots. Gula small, triangular. Setae at anterior margin of frontoclypeus thin and light; lateral seta situated lateral to the frontal suture; intermediate seta smaller than lateral or median seta;
213 median and especially anterior frontal seta small; posterior seta markedly longer. Seta 9 longer than seta 7; seta 8 slightly displaced from the anterior margin of the head; setae 11 and 10 very small and light; setae 14, 15 and 12 long and dark and of about the same length; seta 12 slightly thicker than the others; seta 16 shorter than setae 12, 14 and 15; seta 17 situated near the angle of the frontal sutures, rudimentary; ventral seta 18 small, strong, situated at about the middle of the gular suture.

Labrum (Figure 183) uniformly rounded anteriorly and laterally, with a broad margin covered with small setae; dorsal sclerite thin and yellowish, with a broad rounded median notch; seta 1 light, curved; the membrane in the median notch with the small seta 4; setae 2 and 5 longer and stronger than the others, situated anteriorly, lateral to the sclerite; seta 3 light, recumbent, situated posterior to seta 5; seta 6 situated more medially, small and thin.

Mandibles (Figure 184) without distal teeth; apex slightly blunt; a small basal tooth only on the right mandible; transverse groove distinct; the 2 outer setae situated close together, the basoventral seta between them dark, longer than the apical seta, which is curved and light.

Maxillolabium (Figure 185) long. Pregula forming a broad dark brown sclerite fused with the relatively light gula; submentum forming a short, transverse sclerite with slightly concave anterior margin and convex posterior margin; its posterior angles rounded; the setae are small, thin, situated anteriorly, near the angles of the sclerite; cardo broad, resembling the pregula, dark, with a small ventral seta; stipes forming an oblique brown sclerite with 2 setae, a longer basal seta and a shorter apical seta. Palpiger broad; apical seta of palpiger situated on a membrane at its anterior angle, the basal small seta in the median corner. Maxillary palps relatively long; segments 1 and 3 not sclerotized completely; the 2nd segment is the longest; 4th segment longer than 3rd, with small sensillae; galea cylindrical; with a mediobasal notch; setae and sensillae mainly concentrated on the distal membranous part. Mentum with an indistinct, narrow, median stripe (Nielsen, 1942:334); ventral sclerites small, light, with a short seta; sclerite of labial palpiger crescent-shaped, broad; labial palps clearly marked.

Pronotum (Figure 186) mainly light brown, with a broad, black posterior margin; posterior angles of pronotum black, projecting, slightly curved ventrally; posterior half of lateral margin broadly black; anterior part of lateral margin with a narrow dark stripe some distance from the margin; this dark stripe is hardly noticeable in light specimens; anterior angle with a black spot and near it, a small light notch in the narrow dark border of the anterior margin. Posterior half of pronotum with a broad dark brown spot; several dots in the middle of this field, near its posterior margin; two larger groups of dots in the lateral part; a curved row of indistinct dots laterally on the anterior part. Two dark, thick anterior-angle setae in the light notch at the anterior angle, a primary and a secondary seta which appears in the 2nd stage; between them a small thin seta; 3 or 4 small setae nearby, on a black spot. Several small setae at the anterior margin in the middle of each half; these setae are thicker than the others. The surface setae are arranged in a transverse row in about the middle of the sclerite; median seta longer and darker than the others; a large, dark seta near the distal dark margin; a short, thick seta anterior to it, at a distance from the margin.

Meso- and metathorax markedly larger than prothorax, broader posteriorly; the anterior-angle and medioanal setae are larger than the others; anterior-angle seta of metanotum small, that of the mesonotum slightly longer; intermediate and lateral anal setae small and light; a small thin secondary seta near the anterior-angle seta.

Episternal-epimeral region of pleuron of prothorax with a small oblong triangular sclerite whose apex is contiguous with the lateral margin of the pronotum (Figure 187); a deep narrow notch separates the median light part of the episternum from the other part of the sclerite, including the region of the pleural suture and a narrow stripe on the epimeron; seta of epimeron situated on a membrane small and thin. Trochantin with a short fingerlike process, with a dark spot at the base; seta of trochantin situated on the membranous apex of the process; two small setules situated more ventrally on the membrane.

Pleurites of meso- and metathorax reduced to two small sclerites, perpendicular to each other; the small anteriorly-directed sclerite is a part of the episternum and the trochantin is fused with it (Figure 188); seta of
214 trochantin situated near the sclerite, at the base of the gill; seta of epimeron small, situated on a membrane.

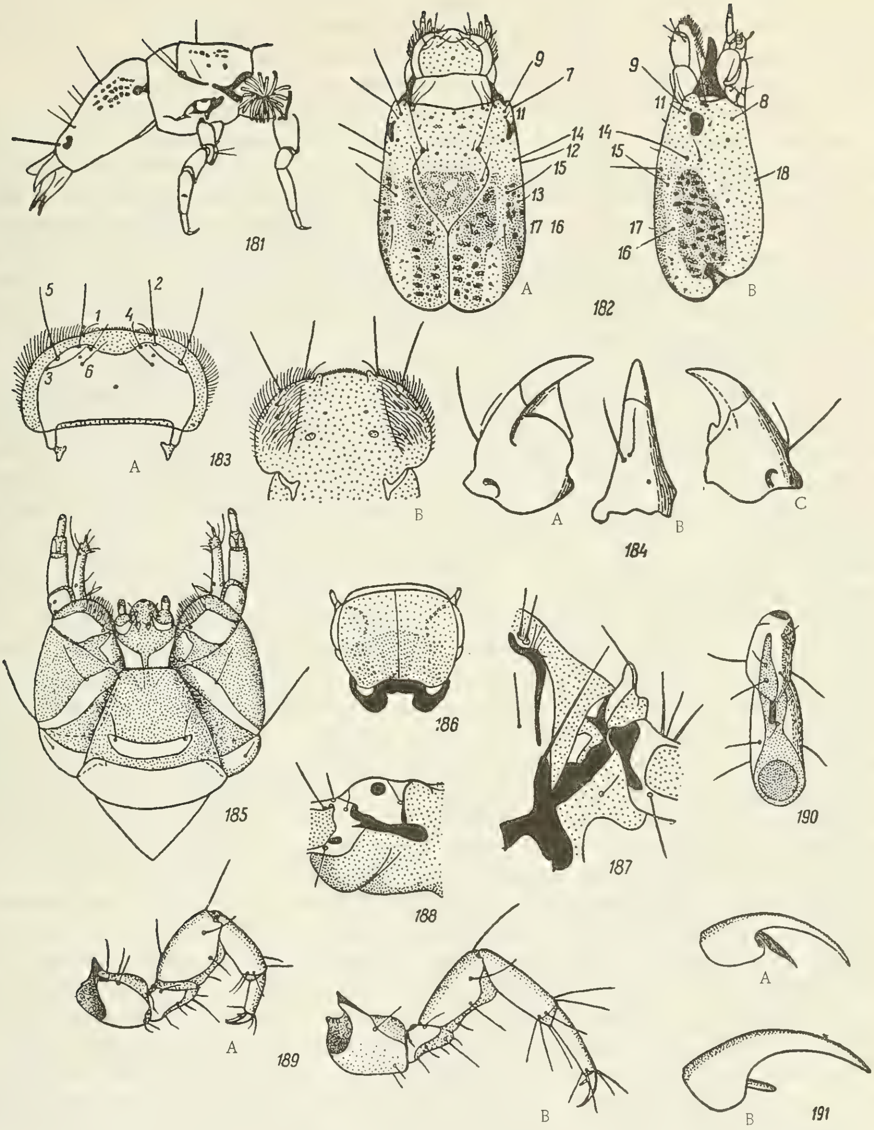
Legs (Figure 189) short; relative length 95:300:112. They are brownish yellow; coxae slightly darker, with a black, beak-shaped process at the basal margin; dorsal setae of coxae situated in the basal part, near the apex of the deep distodorsal notch; trochanters and femora with a narrow membrane ventrally (Figure 190).

The 3 dorsal setae of the forecoxa, dark and thick; anterobasal seta longer and stronger than the others, the posterior seta thinner; both anterior surface setae small and thick; one seta is displaced towards the basal setae; distoventral setae small, thick, spinelike; anterior seta smaller than the posterior seta.

Anterior and posterior setae of trochanter, short and thick; all 3 anterior ventral setae situated on the sclerite; basal seta thick and spinelike; apical seta situated at the apex, light and small; both the posteroventral setae situated on a membrane, one in about the middle of the segment, the second further distally and longer than the others. Basodorsal seta of femur shorter than apical dorsal seta which is slightly displaced posteriorly and moderately long; anterior surface seta small, and spinelike; posterior seta short and dark; both setae situated distally; anterior basoventral seta small and spinelike, situated on a membrane; posteroventral seta situated on the sclerite, dark and short. All 6 setae of the tibia thin and short, the subapical dorsal seta shorter than the apical seta; the 4 setae on the tarsi are situated distally; they are small and thin; the two dorsal setae are situated close together; posterior seta longer than anterior seta. Claw thick and short; basal seta in form of a small, dark, blunt spine (Figure 191).

Mid- and hind legs less massive; femora, tibiae and tarsi longer. Anterior dorsal basal seta of coxa not longer than the other two as on the forelegs, but shorter and thinner; anterior surface setae and the distoventral setae slightly longer and situated subapically; only the anterobasal seta of the 5 ventral setae of the trochanter is situated on the margin of the sclerite; the other 4 are situated on the membrane; posterior subapical seta longer than the others; setae of femur of similar length; distobasal anterior surface seta and posteroventral seta slightly longer than on the forelegs; basal dorsal seta thicker, setae of tibia and tarsi are thin and markedly longer than on the forelegs; claw longer and thinner; its basal spine is blunt.

The anterior-angle dorsal seta of the first abdominal segment is very small and light; this seta and the median dorsal seta on segments 2—8 are small, thin and longer than the others; the seta at the anterior margin, the dorsal intermediate and dorsolateral seta and the lateral setae are small; the intermediate seta of the 3 ventral setae which is absent on the first segment is longer than the others on the 2nd to 8th segments, about one third of the length of the longest dorsal abdominal setae.



FIGURES 181–191. Rhyacophila septentrionis McL.:

181 – head, prothorax and part of mesothorax, lateral; 182 – head, dorsal (A) and lateral (B); 183 – labrum, dorsal (A) and ventral (B); 184 – mandibles: left mandible, dorsal (A) and outer (B), right mandible, dorsal (C); 185 – maxillolabium and gula; 186 – pronotum, dorsal; 187 – pronotum, lateral, pleuron of prothorax, base of coxa of foreleg; 188 – pleuron of metathorax, base of coxa of hind leg; 189 – legs: posterior view of foreleg (A) and hind leg (B); 190 – trochanter and femur of foreleg, ventral; 191 – claw of foreleg of 1st-stage larva (A) and of 5th-stage larva (B) (181 – after Hickin, 182–191 – after Nielsen).

The stalk of the abdominal gills of abdominal segments 1—8 consists of a dorsal and ventral branch which forms almost a right angle; dorsal branch covered with filaments on all sides, the ventral branch only on the outer side; a gill bears to 30 filaments in the middle segments; a gill consists of 20—22 filaments on the anterior and posterior segments.

Dorsal sclerite of segment 9 (Figure 192) yellowish brown; its anterior margin curved, with a broad black margin; a shallow median notch at the posterior margin; posterior margin of the small lateral lobes of the sclerite with broad, brown stripes and 4 dark setae; marginal setae (medioanal and anterior-angle seta) thick, dark and long; the intermediate and lateral setae between them small and thin; setae at the anterior margin small, in form of setules; lateroventral seta situated on the sides of the segment, as long as the dorsal setae at the angle.

Anal legs directed posteriorly and slightly laterally; laterodorsal sclerite "b" with a black basal margin and a blackish brown basoventral hook; the sclerite at the base of the hook dark, with a short seta; the oblique longitudinal and transverse grooves of the basal part of sclerite "b" are clearly marked; a group of large dots and a long, dark seta dorsally, near the median margin of the sclerite; its side bears a long sword-shaped process; the distal part of the sclerite is broadly striated in the middle with a short thin basal seta and a long laterally projecting lateral seta; posteriorly and distally, near the margin of the sclerite, is a large, blunt tubercle at the base of which are two symmetrical processes for articulation of the claw. The distoventral sclerite "c" consists of two parts: a ventral part with a short seta and a larger external-lateral part. Claw uniformly curved, with small ventral spines; seta 1 in the basal part the longest; seta 2 short; setae 3, 4, 5 and 6 more or less long and dark; ventral setae 7 and 8 light yellow, curved; seta 8 situated on a small tubercle (Figure 193).

216 **Young larva.** Length of 1st-stage larva 3 mm; width of head of 1st-stage larva 0.27 mm, of 2nd stage 0.39—0.43 mm, of 3rd stage 0.57—0.61 mm, of 4th stage 0.81—0.95 mm, of 5th stage 1.2—1.4 mm. The young larva resembles the full-grown larva, but head and thorax are relatively broader (Figure 194). The dorsal side of the head of the 1st-stage larva, labrum, pronotum and sclerites of abdominal segment 9 dark brown; ventral surface of head, maxillolabium and legs lighter than in the full-grown larva; the dark color of the above organs disappears in the 2nd stage, and the sclerites are mainly light yellow; the dark spot of the frontoclypeus becomes clearly differentiated in the 3rd stage; posterior half of the pronotum darker than the anterior half, but the dots indistinct; the frontal spot has almost the same form in the 4th stage as in the full-grown larva; the dorsal and lateral dark stripes of the head become distinctly separated; the pronotum retains its lighter color; trochantin darker than in the full-grown larva. Setae of head and thorax, especially the anterior-angle setae of the pronotum, relatively longer than in the full-grown larva; however, the setae of the legs are short as in the full-grown larva. The development of the setae on the pronotum is shown in Table 1.*

In the 1st stage, the trochantin forms an equilateral triangle with a slightly concave anterior margin; in the 2nd stage appears a small anterior fingerlike process; this process is already clearly marked in the 3rd stage, but it is not completely formed even in the 4th stage.

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* After Nielsen (1942:341).

TABLE 1

| Setae | Stage | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th |
| Anterior-angle setae ........ | 1 | 2 | 5 | 6 | 5–7 |
| Anterior-marginal setae ...... | 0 | 0 | 1–2 | 3–4 | 4–7 |
| Surface setae ............... | 4 | 4 | 7 | 7 | 7 |

There are no tracheal gills in the 1st stage; they appear in the 2nd stage; the number of gill filaments increases on both sides.

The anterior-angle setae are absent on the 1st abdominal segment in the 1st stage and the medioanal setae are shorter than on the metathorax; the anterior angle and median anal setae on abdominal segments 2–3 are relatively longer than the thoracic setae, they are longer than the width of the segment (Figure 194). The basoventral hook of the dorsolateral sclerite of the anal legs (Figure 195) of the young larva is slightly curved and bears a strong and long spinelike seta in the middle; there are no sclerites with setae at the base of the hook in the 1st stage; the sword-shaped process is absent in the 1st stage and appears in the 2nd stage; this process reaches the middle of the claw in the 3rd stage; it is still slightly shorter in the 4th stage than in the 5th stage. The dorsal tubercle in the distal part of sclerite "b" of the young larva is absent to the 4th stage; the median and lateral seta of this part are present from the 1st stage (like the distodorsal seta of the basal part), but their relative length in the young larva is not the same as in the full-grown larva (Figure 195). The longest seta of the 1st stage (twice as long as the width of the head) is the median seta of the distal sclerite; however, it becomes shorter already after the 1st stage ($^2/_5$ of the width of the head) and continues to become shorter to $^1/_5$ of the width of the head in the 5th stage; the length of the lateral seta of the distal sclerite increases after the 1st molt to $^1/_3$ of the width of the head; it increases during the following molts to $^7/_{10}$ of the width of the head; the length of the distal seta of the basal part of the sclerite increases from $^1/_4$ of the width of the head in the 1st stage to $^2/_5$ of its width in the 5th stage.*

**Pupa.** Length of male pupa 11.2–12.2 mm, of female pupa 12.4–15.5 mm. Antennae reaching the 8th abdominal segment in male pupae and the 5th segment in female pupae; basal segment with a small median seta and two slightly longer lateral setae. The 3 lateral setae of the anteclypeus are situated close together; lateral seta directed laterally; the other two setae are of almost the same length, longer than the setae of the labrum (Figure 196). Labrum darker than the clypeus, 2.5 times as broad as long; setae 5 in number, dark, long and directed upward. Mandibles (Figure 197) brown, darker at the end; left mandible with 2 pointed teeth; right mandible with 3 pointed teeth; blade and teeth (except the basal tooth) serrated; the
218 distodorsal of the 2 external setae is shorter and curved.

The wing sheaths extend in male pupae to the 5th abdominal segment and to the 4th abdominal segment in female pupae. Segments 1–4 of the midlegs bear dense natatorial setae; the dorsal row consists of brownish black setae to 0.5 mm long, the ventral row of lighter, shorter and thinner setae; 5th tarsal segment with a short distodorsal process which is slightly sclerotized at the apex on the midleg; pretasus with two sickle-shaped light brown claws with a soft cylindrical process of the same length between them (Figure 135, A).

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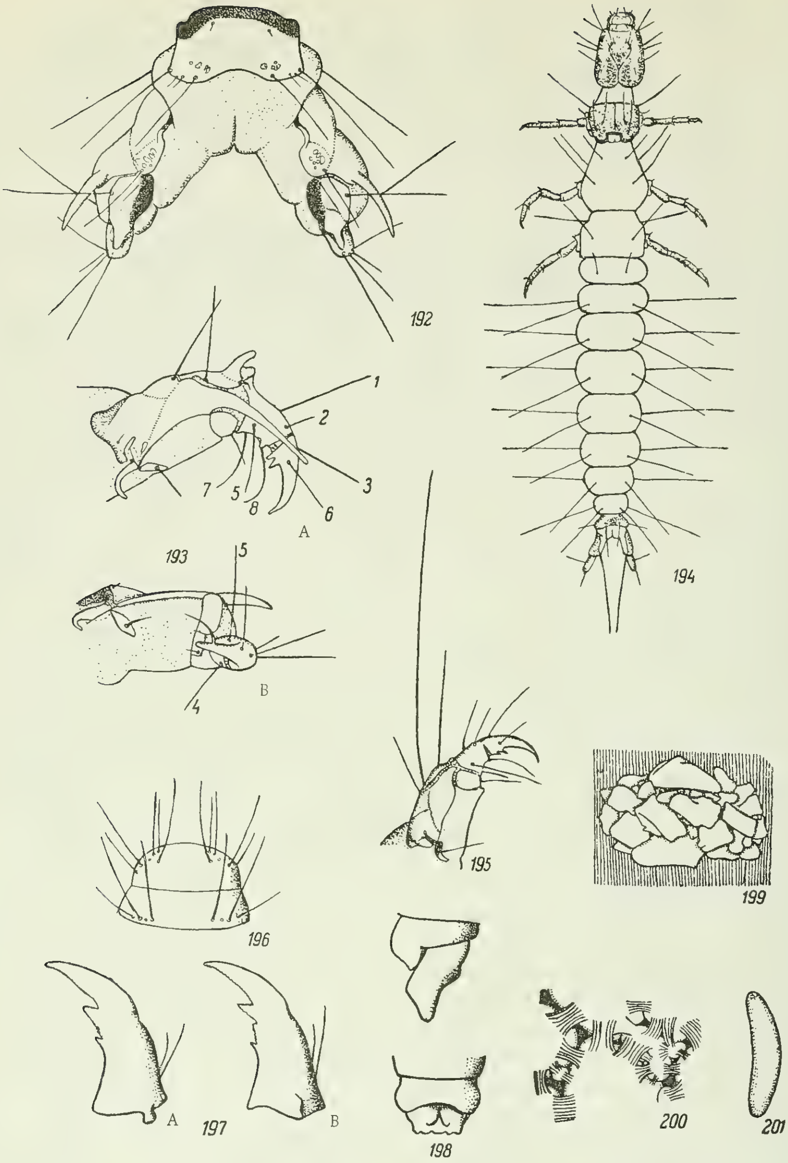
* All measurements after Nielsen (1942:351).

217)



FIGURES 192–201. Rhyacophila septentrionis McL.:

192 – abdominal segment 9 and anal legs, dorsal; 193 – left anal leg, outer view (A) and ventral (B); 194 – 1st-stage larva; 195 – anal leg of 1st-stage larva; 196 – anteclypeus and labrum of pupa, dorsal; 197 – mandibles of pupa: left mandible, ventral (A), right mandible, dorsal (B); 198 – end of body of male pupa, dorsal and female pupa, ventral; 199 – pupal case; 200 – part of wall of pupal case, inner view; 201 – cocoon of pupa (after Nielsen).

Presegmental plates present on segments 4—7, postsegmental plates on segments 3—5; the plates are light brown, rounded and thick; spinules small, dense and numerous. Their numbers are as follows: 3rd:32; 4th:25 + 55; 5th:45 + 36; 6th:36; 7th:22.

End of abdomen of female pupae blunt; segments 9 and 10 indistinctly separated; 10th segment of male pupae with two lateral lobes; sheaths of the lower appendages broad and long, slightly flattened, obliquely truncate; penis tapering (Figure 198).

The pupa is situated in a cavelike, ventrally open case consisting of coarse, small stones with sand grains between them (Figure 199); there are numerous openings between the mineral particles which are connected by strands of tissue (Figure 200); the pupa lies in a thick brown cocoon with ends that are attached to the case at one point (Figure 201).

Mode of life and habitats. Rapidly running brooks and rivulets, on the lower surface of stones in cool water.

Distribution. Northwest, west and southwest of the European USSR, and also Europe.

### 2. **Rhyacophila obliterata** McLachlan

Mackereth, 1954:149—150, Figures 1, 3. — Kachalova, 1957:175—178, Figures 1—3.

**Full-grown larva.** This species is closely related to Rh. septentrionis. Length 16—18 mm. Head (Figure 202) oblong, broader anteriorly than in Rh. septentrionis; it widens slightly and gradually posteriorly; sides of head appear almost parallel; in dorsal view the lateral margins of the head are less uniformly rounded posteriorly than in Rh. septentrionis. Dorsal and lateral stripes of head distinct; between them a small, darker area with light spots at the base of setae 15 and 16. Dorsal stripes blackish brown in the anterior part, almost black near the frontal sutures; dots on them indistinct; posterior part of the stripes less dark; dark dots distinct; the difference in color between the anterior and posterior parts of the stripes is more sharply marked in Rh. obliterata than in Rh. septentrionis. Lateral stripes with distinct dark dots.

Pronotum (Figure 203) with broad black posterior margin; the median dark field with two dots posteriorly; the large lateral field with numerous distinct dots; space between both fields darker than the yellowish brown ground color.

The claw of the anal legs has ventral tubercle at the base of seta 8 and two spines in its distal part; the tubercle and spines are slightly smaller than in Th. septentrionis but are clearly marked.

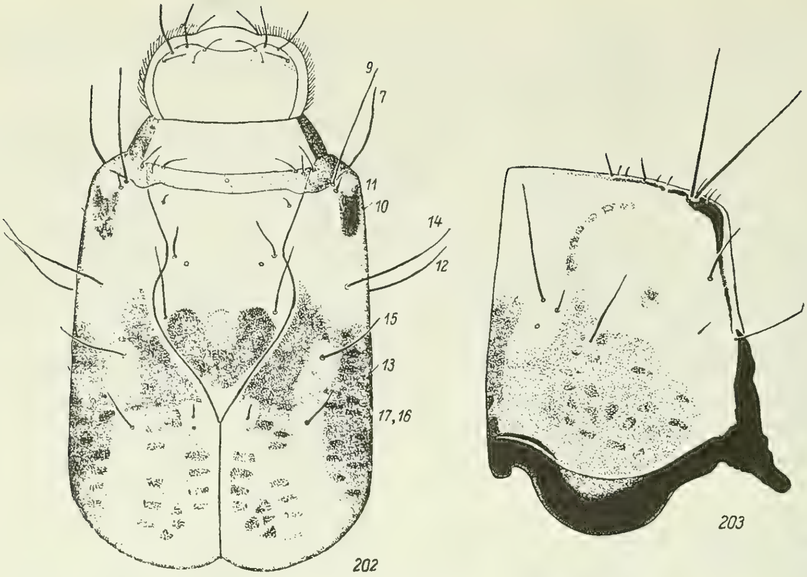
Mode of life and habitats. Brooks under stones.

Distribution. North and northeast of the European part of the USSR, it extends into the northwest of West Siberia (Obdor Tundra); rare; north Central Europe.

### 3. **Rhyacophila cupressorum** Martynov, larva nova

**Full-grown larva.** Length 18—20 mm. Ground color of sclerites yellowish white. Dark spot in posterior part of frontoclypeus less broad, more

(219)



FIGURES 202 and 203. Rhyacophila obliterata McL. (after Kachalova): 202 — head, dorsal; 203 — pronotum.

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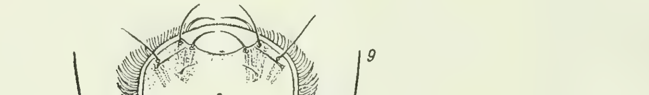
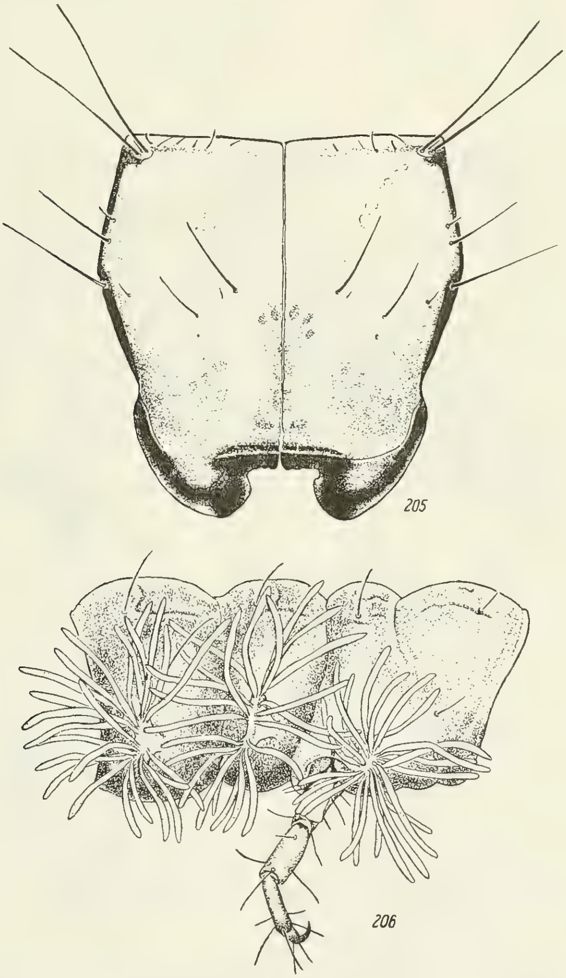


FIGURE 204. Rhyacophila cupressorum Mart. Head, dorsal (A) and ventral (B)

arc-shaped than heart-shaped, with a transverse row of three light spots (Figure 204). Dorsal stripes distinct, not fused with the lateral stripes; they are not very dark, especially in the posterior part; lateral and dorsal stripes with distinct, large, dark dots. Space between dorsal and lateral stripes (in which setae 15 and 16 are situated) of the same light color as the anterior part of the head. Setae not as dark as in Rh. septentrionis and Rh. obliterata, reddish brown. Labrum and mandibles as in the other two proceding species.

Pronotum (Figure 205) mainly light; dark figure in its posterior part with dark dots; spots in each half of pronotum are not so large as in
220 Rh. septentrionis and Rh. obliterata; they are slightly dark and bear large, distinct dots; the curved row of dots of the anterior part of the pronotum is indistinct.

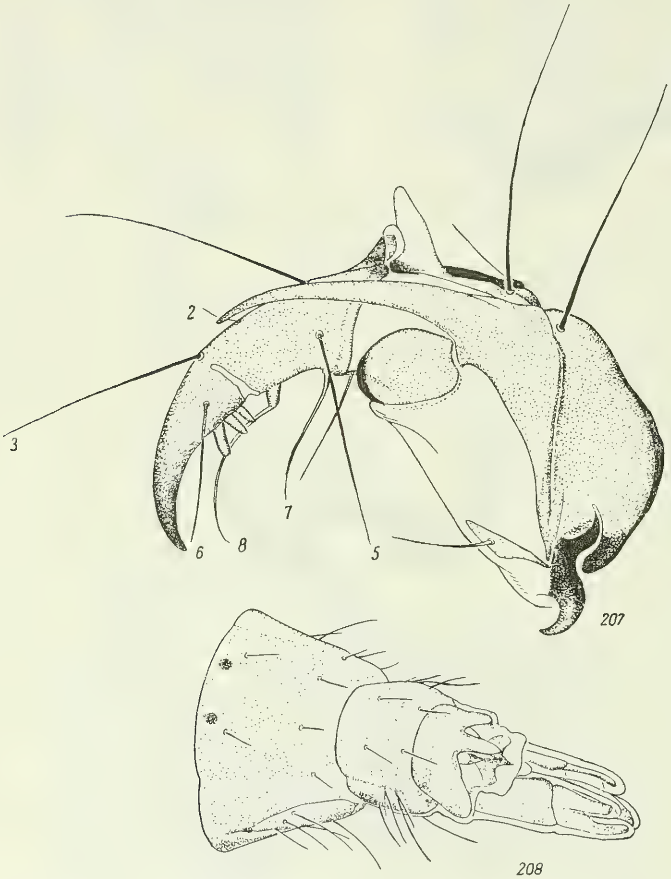


FIGURES 205 and 206. Rhyacophila cupressorum Mart.:

205 – pronotum; 206 – metathorax, and abdominal segments 1 and 2, lateral.

Thoracic and abdominal gills with thin, long filaments which are characteristic for the species (Figure 206).

The dorsolateral sclerite of the anal legs (Figure 207) is light yellow, without spots; distodorsal tubercle blunt and high; claw-shaped process as in the other species of the group; basoventral hook massive and black. Basal part of sclerite with a long, dark seta; distal part with 2 setae, a similar strong, longer seta and a shorter seta at the median margin. Setae 1, 3, 4 and 5 of the claw long and dark; seta 6 shorter; seta 2 thin and short; ventral setae 7 and 8 light, curved; tubercle at the base of seta 8 blunt
221 and large; ventral spinules of distal part blunt, 2 or 3 in number; the most distal spinule smaller than the other two.



FIGURES 207 and 208. Rhyacophila cupressorum Mart.:

207 — anal leg, outer view; 208 — end of body of a full-grown male pupa, dorsal.

The larvae are identified by the sclerotized parts of the exuviae in the cocoon of a male pupa of Rhyacophila cupressorum Mart. with fully developed genitalia (Figure 208). Martynov (1934:46–49) considers Rh. cupressorum to be closely related to Rh. simulatrix McL., which was placed by Döhler (1950:290) in the subgenus Rhyacophila s. str.

Mode of life and habitats. Shallow mountain rivulets with a stony bottom.

Distribution. Caucasus, including the main range and Transcaucasia.

### 4. **Rhyacophila nubila** Zetterstedt

Klapalek, 1888:57–59, Figure 20. – Struck, 1903:79, Plate IV, Figure 5. – Ulmer, 1903:127; 1909:219, Figure 344, a. – Siltala, 1905:141–146. – Lestage, 1921:415–418. – Lepneva, 1940:200.

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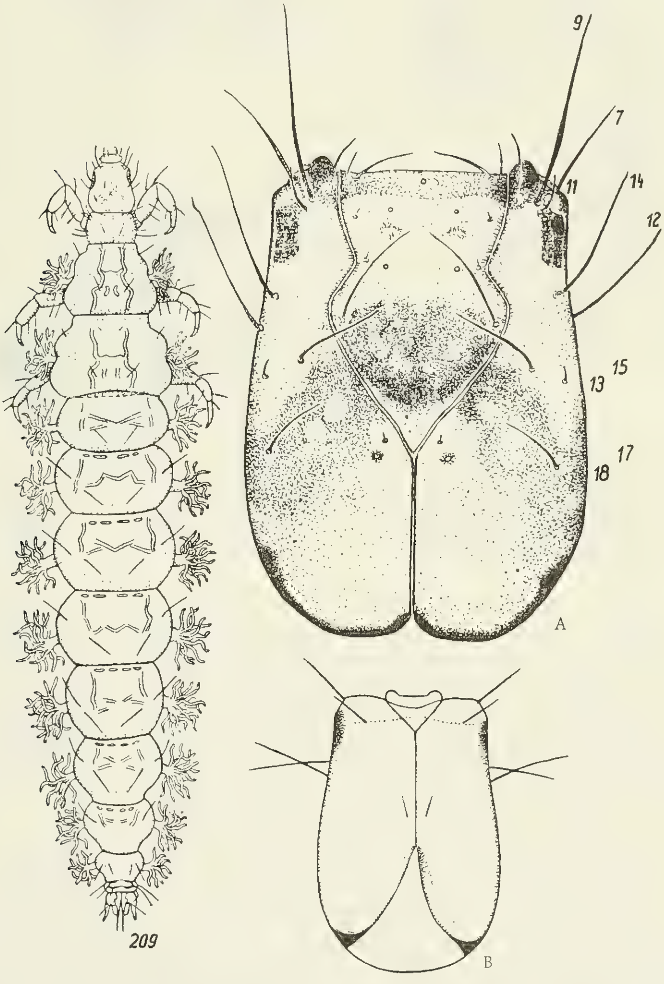
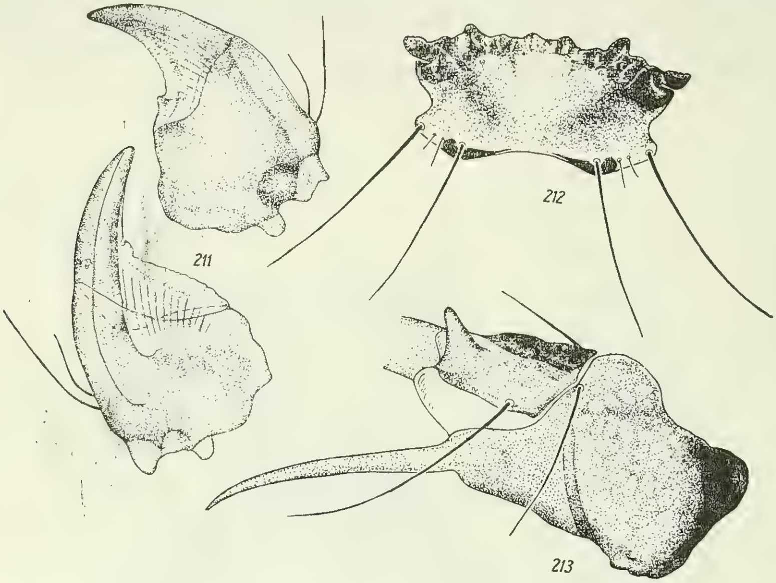


FIGURES 209 and 210. Rhyacophila nubila Zett.:

209 – general view of larva; 210 – head, dorsal (A) and ventral (B).

**Full-grown larva.** Length 20.0–20.5 mm (Figure 209). Dorsal surface of head (Figure 210, A) yellowish brown with a distinct dark pattern; frontoclypeus posteriorly with a blackish brown heart-shaped figure with a transverse row of dots leaving the posterior angle of the sclerite light. Dorsal stripes short, dark and fused with the lateral stripes; white round spots at the base of setae 15 and 16; dots on the stripes distinct; a broad, light space posteriorly, at the sides of the coronal suture. Ventral surface of the head (Figure 210, B) without spots.

(223)



FIGURES 211–213. Rhyacophila nubila Zett.:

211 – mandibles, dorsal; 212 – dorsal sclerite of segment 9; 213 – left anal leg (external; slightly dorsal view) and base of claw.

Dorsal sclerite of labrum light yellow, with indistinct margin. Setae 2 and 5 brown and thick; all other setae thin, light and almost transparent; seta 3 is curved to the sclerite and is hardly noticeable. Mandibles dark
223 (Figure 211); lower blade of the left mandible serrated; basal denticle of the blade larger than the others; blade of right mandible indistinctly serrated; dorsodistal outer seta of mandibles light, short and curved; basoventral seta straight, dark brown and much longer. Sclerites of maxillolabium light yellow; submentum slightly larger than in Rh. septentrionis, with almost straight anterior margin; setae small and light, situated at a distance from the anterior margin.

Pronotum yellowish brown, its posterior margin broadly black, with a brown transverse stripe in the middle of each half; posterior angles prolonged and black; lateral margin of the posterior part with a black border; lateral margin of anterior part with a narrow blackish brown stripe; anterior angles black; anterior margin with narrow dashes laterally. A large dark brown figure occupies the greater part of the posterior part of the pronotum; this figure bears groups of dots which are not always distinct. Two long setae, a primary and a secondary, in the light anterior-angle notch; the seta between them small and indistinct; anterior margin near the notch with 3 or 4 small setae, the anterior angle with 2 or 3; surface setae as in Rh. septentrionis.

Legs yellow and without dots; tarsi and claws brownish; dark spots near the tibiofemoral articulation, on femur and tibia. Setae as in Rh. septentrionis.

Dorsum of abdominal segments with a delicate light pattern consisting of dashes on the anterior margin, two longitudinal stripes and transverse and oblique dashes on the posterior margin which are distinct on the greenish background in live specimens and on the violet background in freshly fixed specimens. As in all species of Rhyacophila s. str., the tracheal gills consist of a short, thick ventral branch with filaments near the apex, and of a longer, thinner dorsal branch with filaments on its dorsal side; each gill has 16—20 filaments.

The dorsal sclerite of segment 9 has a broad serrated, black anterior margin (Figure 212); narrow, sometimes interrupted black stripes are present on the lobes near the posterior margin; the setae at the end of the
224 lobes (anterior angle and medioanal seta) are black; between them a small, thin intermediate seta and a lateral seta; anterior-angle setae small and hardly noticeable. Sclerites of anal legs brownish, with indistinct dots; Basal and median margin broad and black (Figure 213); setae of claw (except the light setae 7 and 8) black.

**Pupa.** Length 12.0—14.5 mm. Antennae of male pupa extending to abdominal segments 7—8, those of the female pupa to abdominal segment 5; blade of left mandible with 2 teeth, blade of right mandible with 3 teeth; the blades are serrated, except the basal tooth.

Wing sheaths extending to abdominal segments 4—5; natatorial setae present on segments 1—4 of the mid-tarsi; they are sparse on the 1st segment. Claws of forelegs and midlegs thick and pointed; those of hind legs weaker and less curved. Number of spinules of the holding apparatus as follows: III : 0+ 25—30; IV : 20—35+ 35—45; V : 4—50+ 30—35; VI : 35—40; VII : 30—35.

Pupal case built of small stones or large sand grains, 20 mm long, about 17 mm broad. Pupa with a wide, semitransparent cocoon which is 13—17 mm long and 3.0—3.5 mm broad.

Mode of life and habitats. Brooks and small rivulets with cool water, on solid bottom, usually on stones, often on pieces of wood.

Distribution. European USSR, mainly North and Northwest, common in the Northern and Central Urals, rare in the Caucasus. Also: Europe, Iran.

### 5. **Rhyacophila subnubila** Martynov, larva nova

**Full-grown larva.** Smaller and of lighter color than Rh. nubila; length 15—17 mm; main coloration of sclerites whitish; pattern brown, sometimes pale; dots indistinct. The species closely resembles Rh. nubila. The head is oblong, about 0.65 as broad as long; pattern distinct. The dark spot in the posterior part of the frontoclypeus of the same form as in Rh. nubila, with straight anterior margin and truncated anterior angles, situated posterior to the frontal setae; the curved row of 4 or 5 dots is not always distinct; the posterior angle of the sclerite is light. Dorsal stripes on the head brown or dark brown, as in Rh. nubila; they are short and usually extend only to the bifurcation of the epicranial suture; they are fused with the lateral stripes into a large and more or less uniformly dark spot with a small light spot at the base of seta 16; seta 15 situated near the anterior margin of the spot, on a light background, in the notch between the stripes; dots on the stripes indistinct; the broad space lateral to the coronal suture usually remains light as in Rh. nubila; more rarely, relatively distinct rows of dots are perceived along coronal sutures in dark specimens.

Dorsal sclerite of labrum whitish yellow.

The large setae on head and labrum are blackish and thick.

Pronotum light in its anterior part and in the greater part of the lateral part with indistinct pinkish brown, curved stripes on the sides; the trapezoidal, broad dark figure in the posterior part is brownish, with indistinct dots along the median suture and more distinct groups of dots on the sides. The brown cross stripes in the broad parts of the black posterior margin of the sclerite are narrower than in Rh. nubila; they are sometimes incomplete, not reaching the anterior or posterior margin of the border; lateral margin as in Rh. nubila and Rh. septentrionis; it is broadly black in the posterior part; there is a narrow dark stripe which extends also to the anterior angle of the sclerite. The large setae darker and stronger than in Rh. nubila.

The sides of the anterior part of the dorsal sclerite of abdominal segment 9 have a broad black margin which is narrower in the middle; this dorsal sclerite is sometimes brownish or interrupted; a chestnut-brown, triangular spot which does not reach the apex of the posterior margin and bears reddish brown stripes on the sides on a convex part in the middle; only these oblique stripes are present in light specimens; the black dashes on the lobes of the posterior margin are narrow; the other parts of the sclerite are whitish yellow.

Both spinules in the distal part of the claw of the anal legs are relatively large.

Mode of life and habitats. Mountain brooks and rivulets with cool water.

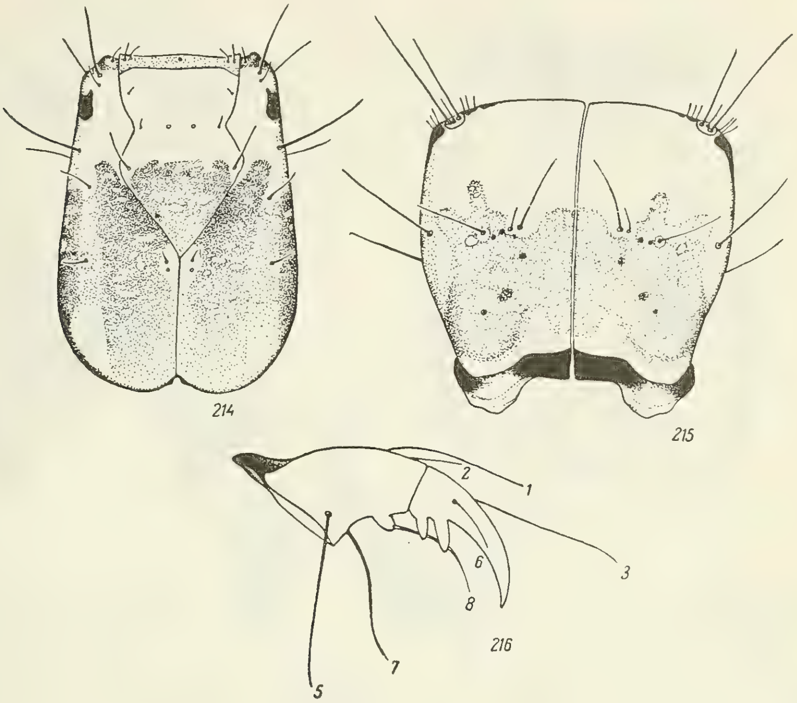
Distribution. Greater and Lesser Caucasus, Iran.

### 6. Rhyacophila dorsalis Curtis

Hickin, 1942:14–16, Figures 1–10; 1954:60–61, Figures 3, a, 4, a, 5, a. — Marlier, 1953b:1–3, Figures 1–4. — Mackereth, 1954:147–152, Figures 1, D, 2, D, 3, D.

225 **Full-grown larva.** This species closely resembles Rh. nubila Zett. in size, coloration and other characters. Ground color of head (Figure 214) light yellow; triangular spot in posterior part of frontal sclerite dark; unlike in Rh. nubila, this spot covers posterior angle of sclerite, and bears a

transverse row of 4 large, lighter dots. Dorsal stripes on head brown, dark, almost fused with lateral stripes which extend close to coronal suture; only a narrow light stripe along suture; dots on stripes not always distinct; light, round spots at base of setae 15 and 16.



FIGURES 214–216. Rhyacophila dorsalis Curt:

214 — head, dorsal; 215 — pronotum; 216 — claw of left anal leg, outer view (215 — modified after Hickin; other drawings after Mackereth).

Pronotum (Figure 215) yellowish in the anterior part; its posterior part is almost completely covered by the transverse, dark brown figure with groups of dots in the middle of each half, as in Rh. nubila.

Claw of anal legs (Figure 216) with a large tubercle at the base of seta 8; ventral spinules of the distal part of the claw also rather large, differing little in size, 2, sometimes 3, in number.

Mode of life and habitats. Rapidly running brooks, on stony bottom.

Distribution. Not recorded from the USSR, but possibly occurring in the southwest and west; Europe.

### 7. **Rhyacophila vulgaris** Pictet

Pictet, 1834:182–184, Plate XV, Figure 1.— Hagen, 1864:143.— Ulmer, 1902c:492, Figures 24–25; 1903:127; 1909:219, Figure 344.— Lestage, 1921:415–417.

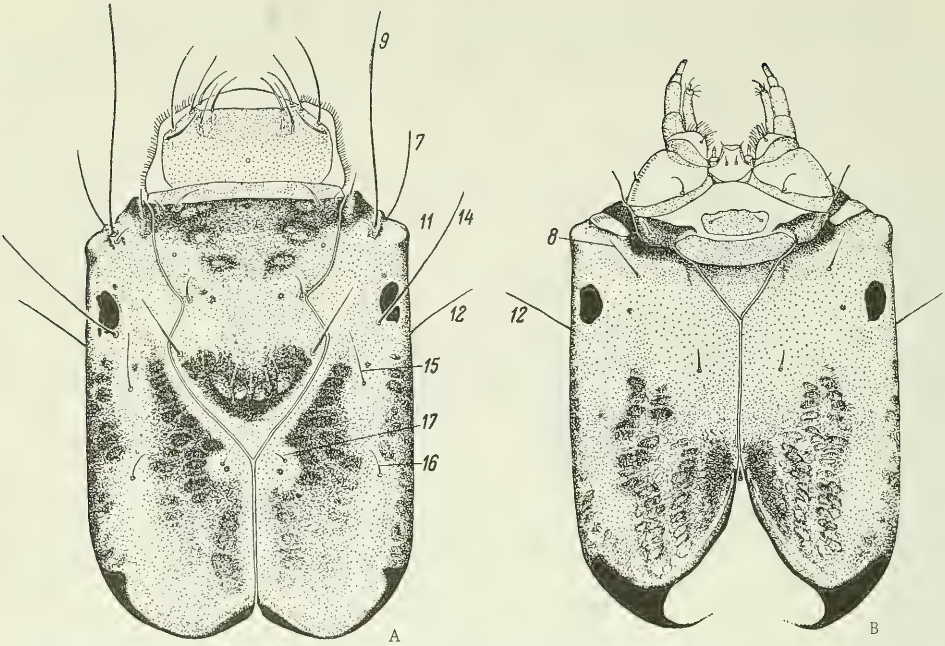


FIGURE 217. Rhyacophila subovata Mart. Head, dorsal (A) and ventral (B)

**Full-grown larva.** Length 20.0—20.5 mm. Light colored; ground color of sclerites whitish yellow. The dark figure on the frontoclypeus covers the posterior angle and bears several light dots. Dorsal and lateral stripes little marked; they are replaced by longitudinal rows of dots on a grayish brown background. No dark figure in the posterior part of the pronotum; the dots along the median suture and in both halves of the sclerite distinct on a slightly dark background.

Mode of life and habitats. Brooks with cool water.

Distribution. Not recorded from the USSR, but possibly occurring in the west and southwest. Europe.

### 8. **Rhyacophila subovata** Martynov

Lepneva, 1959:655—661, Figures 1—4.

**Full-grown larva.** Length 18—20 mm. Head (Figure 217) relatively broad, of a characteristic form, nearly square in dorsal view, with almost 227 parallel sides; eyes slightly projecting laterally. Main color of head and body light yellow. Anterior part of frontoclypeus slightly dark, with 3 pairs of large dots; tentorial pits brownish; large blackish brown spot in the posterior part of the sclerite which is triangular in dark specimens, with straight anterior margin; it is bean-shaped in light specimens, slightly concave anteriorly and rounded posteriorly; this spot bears a curved, transverse row of 4—5 dots, the two marginal dots larger than the others.

Dorsal stripes straight, smoky brown, narrow anteriorly, broader posteriorly, with numerous large blackish brown dots; the part near the bifurcation of the suture with seta 17 is light; the pit behind the seta has a dark border. Lateral stripes unusually broad, relatively long, with longitudinal rows of large dark dots; space between the stripes completely light or with a narrow, slightly dark cross stripe; the short, dark setae 15 and 16 are situated behind each other on a light background. On the ventral side, on the sides of the posterior part, are large dark spots which are fused near the occipital foramen; these spots bear rows of dark dots. There is marked variation in color; the space between the dorsal and lateral stripes is more or less dark in dark specimens; the dark background of the ventral spots is pale in light specimens; there are sometimes only groups of dots; however, the dorsal stripes are not changed or are only narrower.

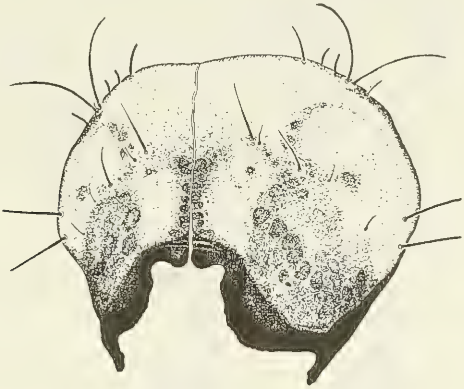


FIGURE 218. Rhyacophila subovata Mart.
Pronotum

Pronotum (Figure 218) yellowish, with broad black posterior margin and posterior part of the lateral margin; the processes of the posterior margin are broad, projecting far posteriorly; they have a small reddish brown part anteriorly; the anterior part of the lateral margin and the part between the anterior angle, and the light notch of the anterior margin have a narrow brownish margin. The smoky brown stripe along the suture is broader anteriorly, and bears indistinct dots; a large dark dot lateral to the base of the row. Both long anterior-angle setae are thick and black; 3rd seta small; medial to the notch, at the margin, are several small thin setae and a short thick dark seta; the medioanal seta and the intermediate seta, which are situated on a dark spot, are shorter than the anterior-angle setae; they are dark, thick, with a small seta near the base; both lateral setae are situated close together; slightly inside to the anterior end of the black lateral margin is a small seta further to the middle.

The gills of the abdominal segments consist of a dorsal upwards-curved branch and of a group of posteriorly-directed filaments at the apex of a stalk on segments 1–5 (13–16–11 in number) and 7–4 in number on segments 6–8; segments 1–4 have an additional small ventral branch with thin, short filaments; the filaments of the dorsal branch are long, especially at the apex; some branches are indistinctly segmented, sometimes bifurcate; the number of filaments is as follows: I : 23, II : 24, III : 23, IV : 18, V : 17, VI : 17, VII : 15, VII : 11.*

(228)

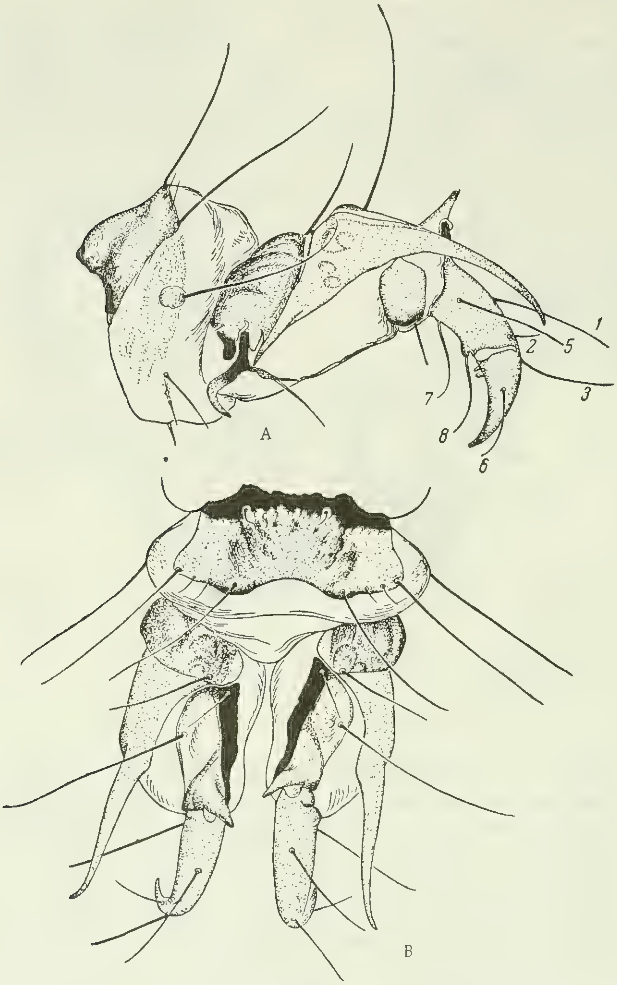


FIGURE 219. Rhyacophila subovata Mart. Segment 9 and anal legs, lateral (A) and dorsal (B)

The sclerite of segment 9 (Figure 219) is light yellow, with oblique, indistinct brownish stripes in each half, or with a median dark spot which tapers posteriorly; the dark anterior margin is broadly black laterally, narrower in the middle; there are large dots in the middle posterior to this border; the black dashes of the posterior margin are narrow; the medioanal seta and the anterior-angle seta which is displaced posteriorly are long and black; the intermediate and lateral setae are small and thin; intermediate seta situated near the outer margin of the black dash, lateral setae on a light background.

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* The number of filaments varies between ± 1–3, as usual.

(229)

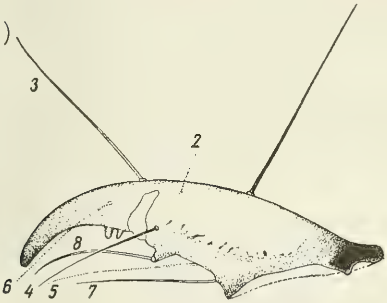


FIGURE 220. Rhyacophila subovata Mart. Claw of anal leg, inner side

228 Sclerite "b" of anal legs with numerous large dots; it bears several dots in the lateral part, dorsally near the base the sword-shaped process is slightly curved and directed posteriorly; the outer seta on the distal part of the sclerite is long and black; the basal part bears a similar, strong and black shorter seta; as usual in species of Rhyacophila s. str., the second distal seta is situated medially at the margin of the claw and is short and thin. The claw (Figures 219 and 220) has a short distal part with 1—2 small, blunt, ventral spinules; the tubercle at the base of seta 8 is large; setae 1, 3 and 5 long and black; setae 6 and 4 shorter, thinner and brown; seta 2 small and thin; setae 8 and 7 light and curved.

229 Before pupation, the larva builds a large, cavelike pupal case which is built of small stones and large gravel grains.

Mode of life and habitats. Mountain brooks and rivulets with a stony bottom.

Distribution. Caucasus.

## 2. Group Hyperrhyacophila Döhler

Döhler, 1950:272—273, 276.

**Full-grown larva.** Length 18—24 mm. The light, anterior-angle depression on the pronotum bears 2 long dark setae (a primary and a secondary) and a small light seta (2nd secondary seta). Abdominal gills conical-pectinate, with a long basal stalk and a short dorsal branch (Figure 224).

Mode of life and habitats. Mountain brooks with cool water and a stony bottom.

Distribution. Caucasus. Europe, southern and central Iran.

### 1. **Rhyacophila vicaria** Martynov (Rhyacophila sp. "larva conibranchia" Lepneva)

Lepneva, 1946:331—332; Figures 8—9; 1957:13.

**Full-grown larva.** Length 18.0—24.1 mm. Ground color of sclerites yellow or whitish yellow. Head not as narrow as in species of Rhyacophila s. str., about 0.78 as broad as long; it is broadest anteriorly, at the level of the eyes; sides parallel in their greater part. The dark figure of the frontoclypeus (Figure 221) is brownish, rhomboidal in its posterior part; it forms a short, broad median stripe with two transverse dots anteriorly; a heart-shaped blackish brown spot with curved row of five dots, two large dots on the sides and small dots in the middle in the posterior angle of the sclerite.

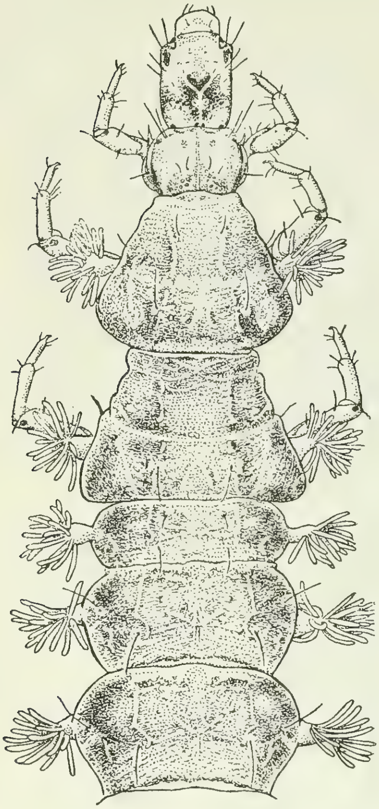


FIGURE 221. Rhyacophila vicaria Mart. Head, thorax and abdominal segments 1–3, dorsal

Dorsal stripes reddish brown, with rows of large blackish dots close to the epicranial suture; these rows are broader near the bifurcation of the suture; they are narrower along the coronal suture; a light spot at the base of seta 17; lateral stripes paler than dorsal stripes, with less distinct dots; the connection between the stripes brownish, with light spots at the base of setae 15 and 16; the stripes are divided by a broad whitish wedge-shaped area posterior to seta 16; head light yellow and without dots ventrally; chaetotaxy as in
230 Rhyacophila s. str.; the large setae reddish brown, relatively shorter than in Rh. septentrionis.

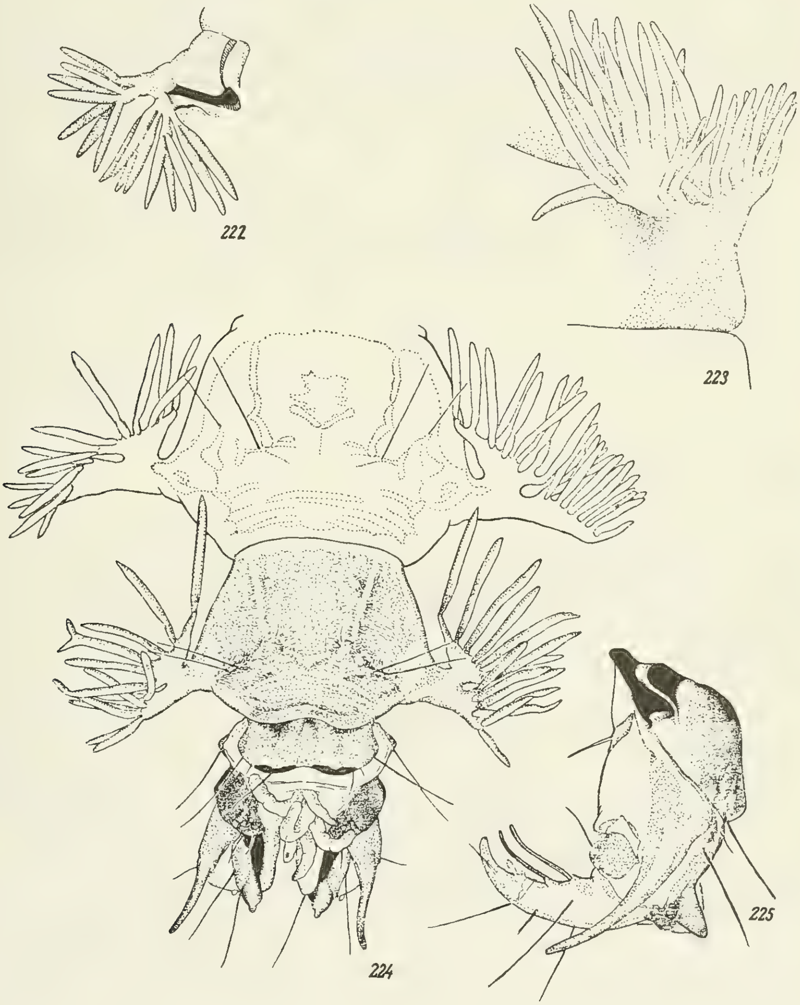
Labrum whitish yellow; the large setae 2, 5 and 6 reddish yellow. Sclerites of maxillolabium dark brown.

Pronotum with a broad black posterior margin which is broader in the middle of each half; however, there are no brown cross stripes; posterior angles long and black; lateral margin of the posterior part black; it has a narrow reddish brown stripe in the remaining part; anterior angle with a small dark brown spot with 3 small setae; the 2 anterior-angle setae in the light depression are moderately long, reddish brown, the seta between them small and light. The sclerite is light yellowish in the greater part of the anterior and lateral parts; a broad chestnut brown figure with a small median process in the posterior part and groups of indistinct dots along the suture and in the middle of each half; the pale curved stripes in the anterior part with brownish dots. Large surface setae, as in the group Rhyacophila s. str.; they are short and reddish brown like the anterior-angle setae.

The thoracic gills consist of a short stalk with a short dorsal branch (Figure 222); filaments slightly thicker than on the abdominal gills; some filaments are indistinctly divided; there are 18–21 filaments. Legs yellowish, with blackish brown spots near the articulations of the trochanter, femur and tibia.

Pattern of respiratory stripes and spots on the dorsal surface of the abdomen distinct, consisting of a row of light dashes near the anterior margin, two longitudinal stripes and a K-shaped figure in the middle of the segment. The abdominal gills consist of a long process in the pleural region of the segment which tapers to a cone and of an upward-curved dorsal branch on the upper surface of the process, which gives a conical-pectinate shape to the gill (Figures 223 and 224); the conical appearance of the gill is especially well marked in ventral view. The anterior-angle and medioanal setae of the dorsum of the abdomen are short and blackish brown; the setae of the 8th segment are situated close to the posterior margin, on a narrow, reddish brown, sclerotized stripe; between them, the sclerotized stripe bears a short, thin intermediate and a lateral seta.

(231)



FIGURES 222–225. Rhyacophila vicaria Mart.:

222 – mesothoracic gill; 223 – gill of abdominal segment 4; 224 – abdominal segments 7–9 and the anal legs, dorsal; 225 – left anal leg, outer view.

The dorsal sclerite of segment 9 is dark in the middle, chestnut brown, lighter laterally, without dots (Figure 224); the black anterior margin is broad laterally and narrower in the middle; posterior margin with black narrow stripes at the base of the medioanal setae; the anterior and medioanal setae are thick, long and blackish brown; intermediate seta short, thin and situated on a dark stripe; the lateral seta is smaller and situated outside the stripe; both setae light.

Basal part of sclerite "b" of anal legs with a broad black border at the base, with a large reddish brown spot and indistinct dots; basoventral hook is massive, slightly curved and reddish at the end (Figure 225); the ventral plate at the base of the hook and the short seta on it are brownish; the sword-shaped process on the lateral part is well developed, blunt at the end; distal part of sclerite "b" with a wide black border in the middle which bears a short thin dark seta; lateral seta of distal part is long, black; seta of the basal part similar but shorter; the outer sclerite of part "c" of the leg is yellowish, with a dark margin in the middle; ventral sclerite dark brown, with a brownish seta (Figure 225).

Claw slightly curved, its distal part much shorter than the basal part and with two ventral spinules; the large dark setae 1, 3 and 5 of the claw are blackish and stout; seta 6 shorter and lighter; seta 2 short and yellowish; the basal median seta 4 is straight and light; setae 7 and 8 are transparent, curved and long, reaching to the end of the claw (Figure 225).

Mode of life and habitats. Mountain brooks and rivulets with a stony bottom and a clean cool water.

Distribution. Caucasus, Transcaucasia, Iran, the Balkans.

### 3. Group Pararhyacophila Döhler

Döhler, 1950:272—274, 284—286.

**Full-grown larva.** Length 19—25 mm. Head larger and broader than in subgenus Rhyacophila s. str.; frontoclypeus with a characteristic rhomboidal figure in the posterior part; the anterior part often slightly or markedly dark. Dorsal and lateral stripes well marked, broad, with numerous distinct dark dots.

231 As in Rhyacophila s. str., anterior-angle depression of the pronotum bears 2 long and a small seta. The thoracic gills consist of a short, thick, sausage-shaped filament which is deeply constricted at the base. Abdominal gills (Figure 227) situated on the sides of segments 1—8, consisting of four short, fingerlike filaments divided by a constriction; the ventral filament is shorter and thinner than the other three; anal legs with a sword-shaped process on the dorsolateral sclerite.

**Young larva.** The number of filaments of the abdominal gills is smaller in 2nd-, 3rd-, and 4th-stage larvae, and each tuft consists of only 2 or 3 filaments.

232 Mode of life and habitats. Mountains; brooks and rivulets with clean cool water, on stony bottom and with more or less rapid current.

Distribution. Greater and Lesser Caucasus. Southern and Central Europe.

Key to Species*

Full-grown larva

1 (2). Head longer than broad; anterior part of frontoclypeus slightly dark, rarely light; ventral side of head light, without dots. Filaments of abdominal gills thick; two dorsal filaments long, with indistinct secondary constrictions in the distal part; ventral filament shorter and thinner than the others, not differing much in color . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **1. Rh. forcipulata** Mart. (p. 243)

2 (1). Head broad, short, only slightly longer than wide; anterior part of frontoclypeus almost completely dark; ventral side of head with longitudinal groups of dark dots. Filaments of abdominal gills less thick, without secondary constrictions in the distal part; ventral filament of tuft shorter, thinner and markedly lighter than the other filaments, sometimes transparent . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **2. Rh. bacurianica** Lepn. (p. 246)

**1. Rhyacophila forcipulata** Martynov (Rhyacophila sp., sp. n.? Mart.; Rhyacophila sp. "larva arthrobranchia" Lepneva)

Martynov, 1926a:25.— Lepneva, 1946:325—330; 1957:13; 1961:652—654.

**Full-grown larva.** Length 18—30 mm;** sclerites light yellow; pattern distinct. Head (Figure 226) slightly oblong (length to breadth = 1:1.2). Frontoclypeus broader than in species of Rhyacophila s. str., with a short anterior part; posterior part markedly longer than anterior part. The dark figure on the posterior part of the sclerite is rhomboidal, with a truncate anterior angle; posterior angle of sclerite dark; area of curved row of light dots darker than the other part of the spot; the row has 2, rarely 3, small light dots in the middle; there is a large dot in the form of a comma at sides; two light dashes at level of posterior frontal seta, lateral to the spot. Anterior part of sclerite usually light; the rhomboidal spot extends anteriorly in a dark median stripe. Dorsal stripes broad and smoky brown, close to epicranial suture, with longitudinal rows of dark dots; lateral stripes shorter, their dots less distinct; the dark connection between the stripes has a light spot at the base of seta 16; ventral side of head light.

Most large setae of the head darker and thicker than in Rhyacophila s. str., especially in Rh. nubila and Rh. septentrionis; seta 9 longer than the others; posterior frontal seta and seta 14 almost as long as seta 9; setae 12, 15 and 16 shorter and also dark; seta 7 dark brown, with a long, thin, lighter end; the small ventral seta 8 is brownish and much larger than the very small light seta 18.

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* Two larvae of the group Pararhyacophila were described as "larva arthrobranchia" and "larva bakurianica" from the Caucasus (Lepneva, 1946:325—331). It was later established from a large amount of material that the "larva arthrobranchia" is the larva of Rh. forcipulata Mart. and the "larva bakurianica" is that of Rh. bakurianica Lepn. (Lepneva, 1957:13; 1961:652—658).

** Full-grown larvae longer than 24 mm were not found in Transcaucasia, in rivers of the Trialet Range in the region of Bakurian and Borzhomi; in the streams of the Main Caucasus (Teberda, along the Voenno-Georgian road) larvae of Rh. forcipulata, 25—30 mm long, are common.

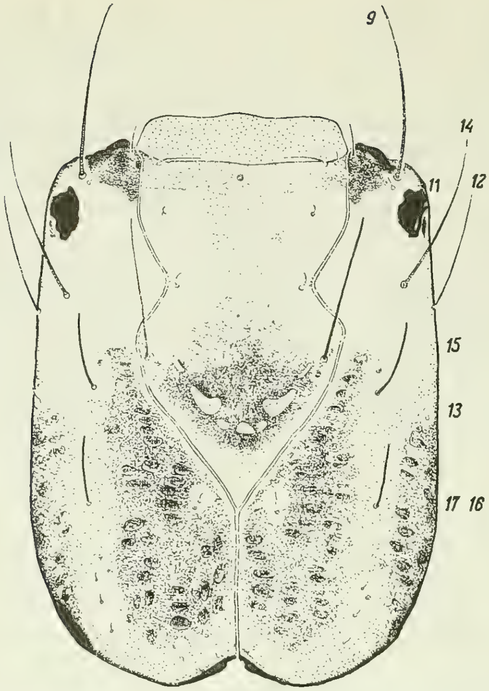


FIGURE 226. Rhyacophila forcipulata Mart. Head, dorsal

Dorsal sclerite of labrum brownish yellow; the large setae 2, 5 and 6 brown; setae 1, 4 and 3 transparent. Mandibles massive, black, short, with a blunt apex; lower blade of left mandible not serrated, basoventral seta brown and straight; distodorsal seta shorter, curved and light.

233 Pronotum with a black posterior margin; this margin is broader in the middle of each half of the sclerite but has no brown cross stripes; posterior angles of the sclerite long and black; posterior third of lateral margin black, the other part is golden brown, with a narrow stripe; anterior angles with a small dark brown spot lateral to the light notch. Sclerite whitish yellow in the middle, in the anterior quarter and the greater part of the sides; dark part of sclerite smoky brown, with small reddish brown dots in a row along the median suture, at the sides of the posterior part and along the curved stripe of the anterior part. The 2 large anterior-angle setae in the light notch (one primary and one secondary) are brownish black and long but shorter than the sclerite; the seta between them is light; a small dark spot nearby bears 3 small yellowish setae; of the small light setae at the anterior margin, the seta situated in the middle of the half of the sclerite is longer than the others and dark. The surface seta in the middle is slightly longer, brownish black; the second surface seta is shorter, and also dark; light spots at the base of both setae; the 3rd seta in the lateral region is small and pale; small light setae near the base of the first 2 setae;

both lateral surface setae short and strong, brownish black; one situated near the black margin and the second slightly anteriorly. The distal seta of the trochantin of the prothorax resembles the lateral setae of the dorsal sclerite.

The anterior part of the pleural region of meso- and metathorax has one sausage-shaped upward-curved tracheal gill which is deeply constricted at the base in the angle formed by the dark sclerites of the pleuron; setae as in Rhyacophila s. str.

Forelegs brown, mid- and hind legs light brown; claws and tarsi of all legs darker than the other segments; chaetotaxy as in Rhyacophila s. str.; the large setae are thicker.

(234)

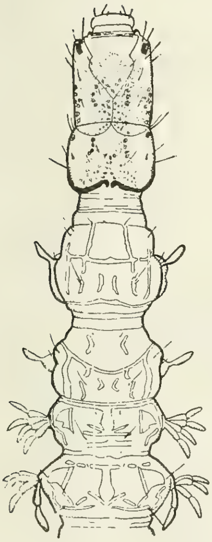
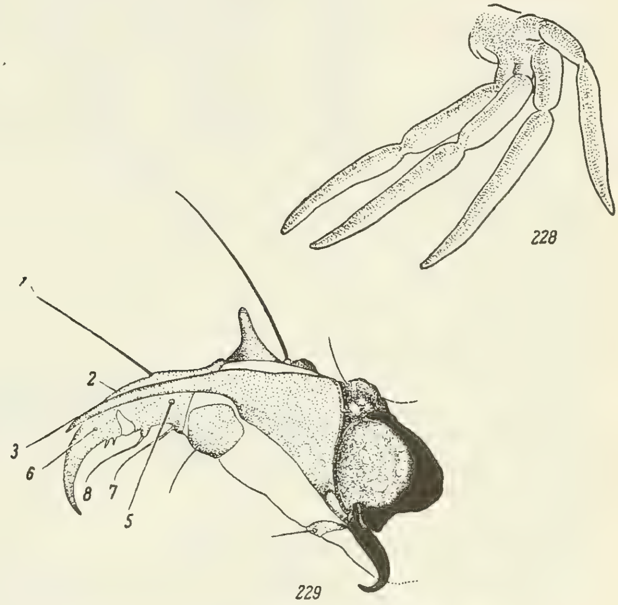


FIGURE 227. Rhyacophila forcipulata Mart. Head, thorax and abdominal segments 1 and 2, dorsal



FIGURES 228 and 229. Rhyacophila forcipulata Mart.:

228 — gill of abdominal segment 6; 229 — right anal leg, outer view.

Abdominal gills present on segments 1—8; each gill (Figure 228) consists of a short stalk with a small process (homologous to the dorsal branch of complex gills) with two distodorsal filaments; the other two filaments are situated more ventrally; all 4 filaments are arranged in a row; they are curved and directed upward, in one plane; the ventral branch is light and thinner; however, it forms one row with the other filaments, and is not opposed to the other 3 like the thumb of the hand, as was assumed by

McLachlan, who described the 4-filamented gills of the larva of Rh. intermedia McL. (MaLachlan, 1874–1880:78; Döhler, 1950:273–274).* Each filament is divided by a deep constriction into two parts, the basal part
234 shorter than the distal part, which is tapering at the end; the two upper filaments sometimes have a second constriction in the distal third, so that the filament appears 3-segmented. The filaments become gradually shorter and thinner on the abdominal segments, especially on segments 7 and 8.

The dorsal sclerite of abdominal segment 9 is brown, without dots; the black anterior margin is continuous, broader in the middle of each half, narrower in the middle; the setae at the anterior margin are small and light, situated near the margin; the posterior margin is marked only in form of black dashlike parts at the base of the medioanal setae, which are black and long; the anterior-angle setae are similar; the intermediate and lateral setae are small and light; the former is situated near the outer margin of the dash; the latter is situated slightly away from this dash. The lateroventral seta is thick and dark, situated on a sclerotized dot on the sides of the segment.

Dorsolateral sclerite "b" of anal legs (Figure 229) chestnut brown, with large light dots which are more numerous in the basal part; the basal and median margin of the sclerite is black, broader in the distal part; the sword-shaped process is long and large; distodorsal tubercle high; basoventral hook reddish brown; plate at the base of the hook golden brown, with a light, short ventral seta; a short thick seta in the mediodistal corner of the basal part of the sclerite; unlike in Rh. septentrionis, this seta is less than half as long as the lateral seta of the distal part, which is also black and thick but much longer; the second (mediobasal) seta of the distal part is small, thin and dark. Sclerite "c" large, dark brown; lateral sclerite with a black ventral margin; seta short and black.

Basal part of the claw longer than apical part (Figure 229); it bears two small blunt ventral spinules; setae 1, 3 and 5 long, strong and black; setae 6
235 and 4 shorter and lighter; seta 2 short and thin; setae 7 and 8 transparent; seta 8 situated on a tubercle.

Mode of life and habitats. Mountain brooks and rivulets, with cool water and stony bottom.

Distribution. Greater and Lesser Caucasus.

### 2. **Rhyacophila bacurianica** Lepneva (Rhyacophila sp. "larva bacurianica" Lepneva)

Lepneva, 1946:330–331, Figures 6–7; 1957:13; 1961:655–658.

**Full-grown larva.** Length 17.0–22.5 mm. Head large, broad, shorter and broader than in Rh. forcipulata; head only slightly longer than broad (Figure 230); anterior part of frontoclypeus shorter than posterior part, completely dark or with a broad dark median stripe; 3 pairs of widely separated dots at the anterior margin; a wide, dark, rhomboidal spot with a curved row of 5–7 light dots in the posterior part; the lateral dots are transverse and narrow.

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* McLachlan accepted Eaton's view and tentatively considered the larva with 4 filaments in the gills as that of Rh. glareosa McL.; this larva is named as such in the keys of Ulmer (1909:219) and Lestage (1921:415); Döhler (1950) proved that this is the larva of Rh. intermedia McL. (cf. Lepneva, 1961: 652–653).

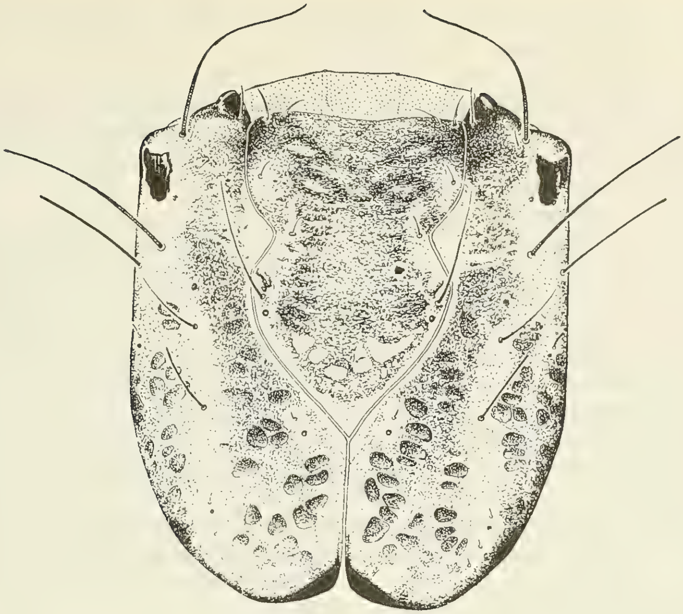
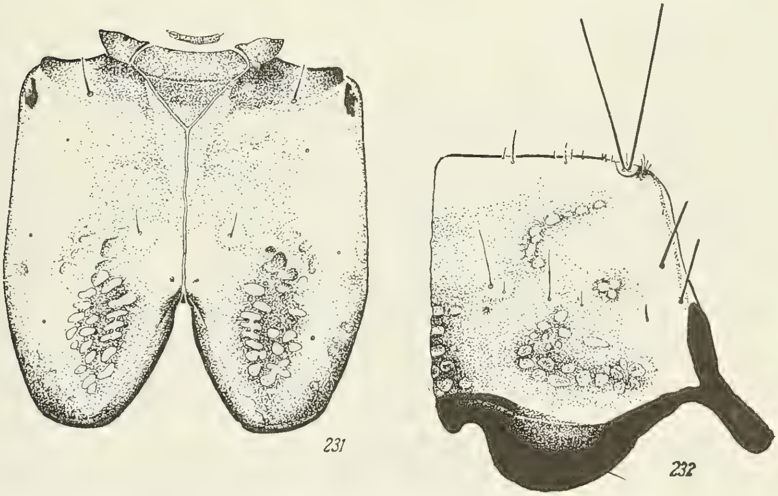


FIGURE 230. Rhyacophila bacurianica Lepn. Head, dorsal

(236)



FIGURES 231 and 232. Rhyacophila bacurianica Lepn.:
231 — head, ventral; 232 — pronotum.

Dorsal stripes broad, smoky brown, close to the epicranial suture, with numerous large dark dots; they extend from the anterior margin of the head to the occiput in dark specimens; lateral stripes also well marked, with large dark dots; the connection between the stripes is broadly dark, with light spots at the base of setae 15 and 16; ventral side with dark stripes with longitudinal rows of large dots (Figure 231).

Chaetotaxy as in Rh. forcipulata, with minor differences.

Pronotum completely dark, smoky brown except in the small anterior-angle part and with large, distinct dark dots. Two of the 5–7 small anterior-margin setae situated inside to the anterior-angle setae are dark and larger than the others (Figure 232).

Thoracic gills shorter than in Rh. forcipulata, with rounded apex; they are pinkish like the first 3 filaments of the abdominal gills in fixed specimens; distal part of filaments of abdominal gills shorter than in Rh. forcipulata; they are blunt and narrower at the apex, without
236 secondary constriction; the first three branches directed upward; ventral branch shorter, thinner and lighter than the others (often almost transparent) and inclined posteriorly.

Dorsal sclerite of segment 9 yellow, without dots; the black anterior margin narrow in the middle; it is broader laterally like the large anterior-angle parts, the black dashes at the base of the medioanal setae small and narrow.

Anal legs slightly shorter than in Rh. forcipulata; dots of sclerite "b" present only in the dorsal part. Claw as in Rh. forcipulata.

Mode of life and habitats. Brooks and rivulets with cool water and stony bottom, mainly in high mountains.

Distribution. Greater and Lesser Caucasus.

## 4. Group Mesorhyacophila Lepneva

Lepneva, 1963:66–67.

**Full-grown larva.** Larvae smaller than in the preceding groups; length 15–19 mm; body slightly flattened dorsoventrally. Submentum as in the preceding groups, with concave anterior margin and convex posterior margin. Pronotum with 2 dark, long anterior-angle setae, one primary and one secondary; 2nd secondary seta small or short. Thoracic gills isolated, sausage-shaped (as in Pararhyacophila), or absent; abdominal tracheal gills absent. Dorsal sclerite of segment 9 broad anteriorly, with large anterior-angle processes extending to the pleural and partly to the ventral side. The sword-shaped process of sclerite "b" of the anal legs is either as in Rhyacophila s. str. in form of a lateral process of sclerite "b," of slightly irregular form or is situated nearby, on a separate small sclerite. The claw bears large ventral spinules in its distal part, little marked spinules, or spinules are absent.

Mode of life and habitats. Brooks and rivulets with stony bottom.

Distribution. USSR: Talass Alatau, Altai, Sayans, Amur Region. Also Japan, Sunda Islands, North America.

### Key to Species

1 (4). Sword-shaped process broader at the base, situated on the distal margin of the lateral part of sclerite "b."

2 (3). Isolated gills present on meso- and metathorax . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Rh. yamanakensis** Iwata (p. 251)

237 3 (2). Gills absent . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Rhyacophila** sp. "larva praebranchiata" Lepn., larva nova

4 (1). Sword-shaped process not broader at the base, situated on a separate small sclerite between sclerites "b" and "c"; gills absent . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. **Rh. impar** Mart.

1. **Rhyacophila** sp. "larva praebranchiata" Lepneva, larva nova*

**Full-grown larva.** (Figure 233). Length 15 mm. Sclerites light brown, setae (except the small setae) dark and strong. Head short, with parallel sides. Frontoclypeus with a wide grayish brown, rhomboidal figure in the posterior part; dots of the transverse row distinct, blackish brown. 238 Dorsal stripes indistinct, reddish brown, close to the frontal and coronal suture, with numerous large, dark dots; indistinct dots on the place of the lateral stripes. The setae of the head are strong and black; the longest setae (setae 9 and 14), and the posterior frontal seta are thick.

Pronotum with continuous broad, black posterior margin; lateral margin of the posterior third also broadly black; anterior angles with a small dark spot. Two long, strong black setae in the anterior-angle notch; the third seta situated anteriorly, between the two above setae; it is thin, reddish brown and well marked; a dark lateral spot bears several small setae; sclerite with numerous dots which are darker and more distinct in the middle; they are lighter and less distinct laterally; the setae are strong, black and relatively short; the medioanal seta larger than the others, with a small thin dark seta at its base; second large surface seta shorter; one of the 2 setae at the lateral margin is situated on the black border, the second is situated slightly more distally, on the light background.

Mesothorax markedly larger than metathorax; dorsal setae relatively large and strong; anterior-margin seta of pronotum long, as usual, and longer than that of the metathorax; the anterior-angle seta of the mesonotum shorter than the anterior-margin seta; the small secondary seta of the metanotum near the primary anterior-angle seta is thin; the strong, black, medioanal seta of the 3 posterior surface setae is longer than the others; the intermediate seta is thin, dark brown, of almost the same length; a small thin lateral seta slightly further posteriorly. The legs are brown; most of the setae are black and strong. Thoracic gills absent, as in Rh. impar.

Abdomen not dorsoventrally flattened; setae dark; the dorsal anterior-margin seta small and thin; the anterior-angle seta is long from the second segment onward; it is displaced on segments 7 and 8 towards the anal setae; the medioanal seta longer than the anterior-angle seta; intermediate seta is thin and long, as on the thoracic nota; lateral seta small but well marked.

The sclerite of abdominal segment 9 is characteristic: it is light in the middle, without a dark anterior margin; a black margin is present only at the sides and on the processes of the anterior angles; these angles are not as projecting and long as in Rhyacophila impar; lateral to the light median field, the sclerite is reddish brown; it is lighter toward the lateral and posterior margin, brown and yellowish; median notch of the posterior margin shallow; near the posterior margin of the lobes on the outer side is a strong black long anterior-angle seta, displaced posteriorly, an intermediate seta and a lateral seta which are thin and small.

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* Eleven larvae were collected by L.K. Sibirtseva (1953–1954) in the tributaries of the Chirchik River in Middle Asia.

(237)

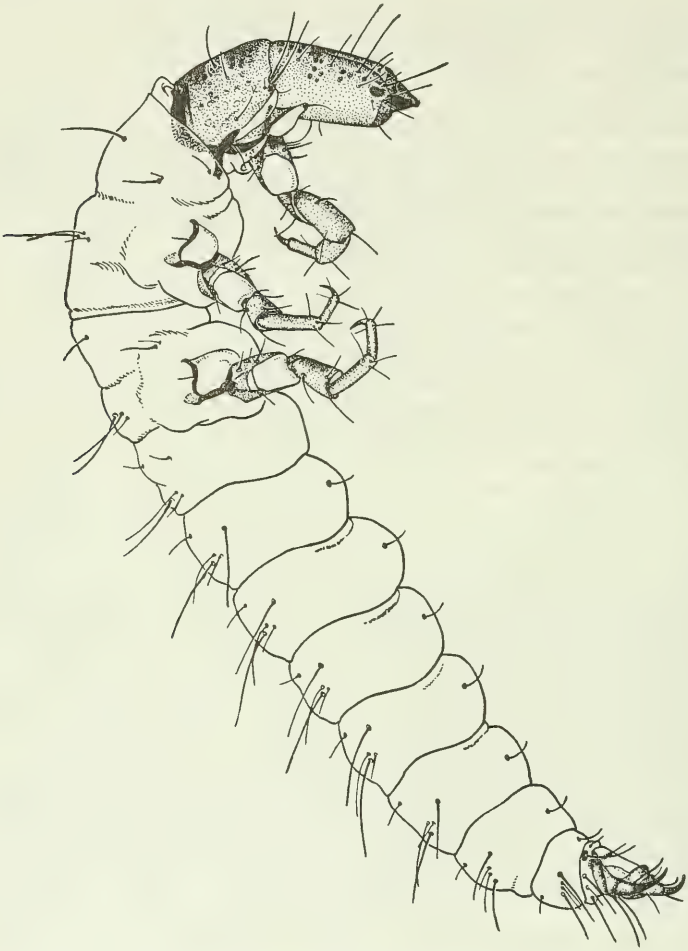

FIGURE 233. Rhyacophila sp. "larva praebranchiata," larva nova, lateral

The basoventral hook of dorsolateral sclerite "b" of the anal legs (Figure 234) is black at the base, pinkish at the end; a brownish sclerite near the light ventral seta; the sword-shaped process of the sclerite is separated at the base from the other part of the sclerite by a narrow light stripe; in the distal part of the sclerite is a low dorsodistal tubercle with rounded apex; 2 long black, thick setae in the middle and laterally; near the posterior margin of the basal part is a short seta which is strong and black, unlike the two other species of the group. Claw with two ventral spinules in its distal part; one of them is very small; ventral seta 8, which stands on a tubercle, and seta 7 are situated in the basal part; both setae are light; seta 4 is situated medially to seta 8; it is thin and light brown; dorsal short seta 2 thin and dark; the other setae black, strong and thick; dorsal setae 1 and 3 are longer than the others; the outer seta 5 is almost the same as setae 1 and 3, but thinner; seta 6 slightly shorter.

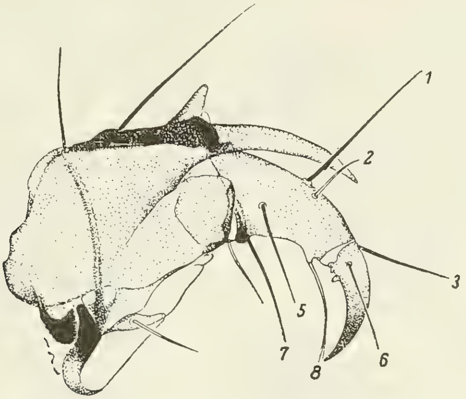

FIGURE 234. Rhyacophila sp. "larva praebranchiata," larva nova. Left anal leg, outer view

Mode of life and habitats. Mountain brooks and rivulets with a rapid current.

Distribution. USSR: Talass Ala Tau in Central Asia; rare.

239 **2. Rhyacophila yamanakensis** Iwata

Iwata, 1927a:205, Figures 28–30. – Lepneva, 1949:164, Figures 4–6.*

**4th and 5th-stage larva.** Length 10.4 mm (Figure 235). Head yellow, with a reddish brown pattern; occipital foramen with a narrow, dark brown margin. Sides of anterior part of frontoclypeus with narrow dark stripes; posterior part of sclerite with a dark heart-shaped figure with a curved row of dots. Dorsal and lateral stripes absent; 3–4 indistinct large light brown dots laterally, along the coronal suture; ventral side of head without dots.

The outer and intermediate setae of the 3 anterior-margin setae lateral to the frontal suture are light and small; the median seta is larger, curved toward the margin of the sclerite; the anterior frontal seta is the same as the above recumbent seta, and directed slightly obliquely; middle seta small and light; posterior seta long and brownish; the other dorsal setae (unlike Rhyacophila s. str.) are thin; their relative size is slightly different from that in Rhyacophila s.str.; seta 9 longer than the others; posterior to it is the small, light seta 11; seta 7 is large, more than half as long as seta 9; seta 10 is small, light, situated on the outer side, near the eye; setae 12 and 14 are situated posterior to the eye; they are almost of the same length; setae 15 and 16 are situated behind each other; they are somewhat lighter and thinner; seta 15 is long, seta 16 is shorter; both setae are slightly curved inward; seta 13 is thin, light and recumbent.

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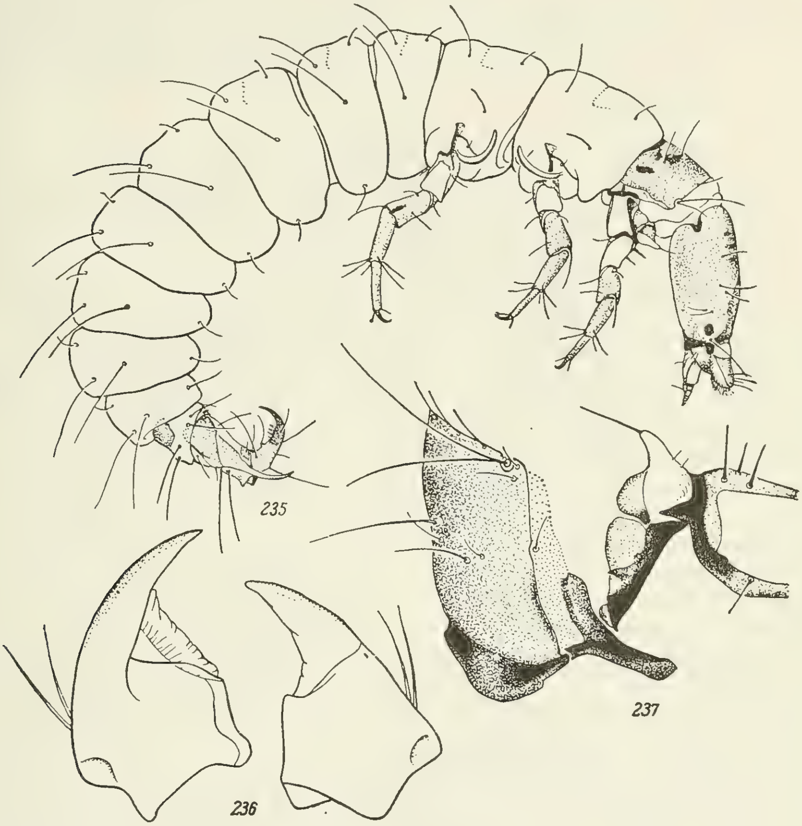
* Described as Rhyacophila sp.

Dorsal sclerite of labrum golden yellow; the membranous margin is white, with short hairs; seta 1 is situated on the membrane; it is transparent and strongly curved; seta 4 small, light; seta 3 short, light, curved inward, but not recumbent; setae 2, 5 and 6 long, brownish and thin; seta 2 situated anteriorly, slightly shorter than the other two; seta 5 situated near the anterior angle; seta 6 situated more medially and posteriorly; unlike Rhyacophila s. str., it is longer than seta 5. Mandibles short and massive as in Rhyacophila s. str.; upper blades without teeth (Figure 236); lower blade of left mandible with a small tubercle near the distal margin of the serrated part; lower blade of right mandible with a blunt indistinct basal tooth; outer setae little different in length; the distodorsal seta situated nearby is shorter and curved.

Gula yellowish. Pregula markedly darker than gula and broader, dark brown; cardo also dark brown; the seta is small and light; submentum brown, crescent-shaped; the setae are small, light, situated near the anterior angles of the sclerite. Sclerites of stipes narrow, light brown; the setae are thin; basal seta much longer than apical seta; mentum golden brown, with a narrow indistinct median suture; palpiger, labial palps and labium yellow, resembling those of Rhyacophila s. str.

Pronotum (Figure 237) brownish, with indistinct dots; posterior margin narrowly black in the middle and laterally; reddish brown cross stripes in each half of the processes; the posterior angles form broad blackish brown processes; a similar broad dark stripe of the posterior third of the lateral margin is directly contiguous to the processes; the other part of the lateral margin and the anterior margin are without a border; anterior angle with a small reddish spot near the margin of the depression. The black lateral margin of the pronotum is separated from the brown surface of the sclerite by a white membranous stripe which is yellow at the base; it extends also anteriorly as a narrow frame of the light part of the lateral margin; the lateral margin of the anterior part of the sclerite is continued posteriorly in a narrow brown stripe in the posterior third, at the boundary with the white stripe which separates the dark lateral border; thus, the pronotum has a double border laterally to the posterior part. Two long reddish brown setae in anterior angle notch of the sclerite, one primary and one secondary; the 2nd secondary seta is short, yellowish, situated on a sclerite near the outer margin of the depression; 3 moderately long thin brownish setae are situated at an equal distance from each other at the anterior margin; between them are 3 or 4 small, thin setae at the margin; a similar light but longer thin seta is situated at the corner of the sclerite; a relatively long seta near the median suture and a shorter seta some distance from the first, as in Rhyacophila s. str., in about the middle; a small light seta laterally, near the base of each seta; a short reddish brown seta near the lateral margin of the brown sclerite, on the whitish, membranous margin, near the distal margin of the dark stripe on the posterior third of the sclerite.

Mesothorax slightly longer than metathorax (Figure 235). Setae on mesonotum thin and light, anterior-margin seta of mesonotum short and well marked, that of the metathorax small and thin; anterior-angle seta light brown and short; medioanal seta longer than the others; intermediate seta small and straight; curved lateral seta very small.



FIGURES 235–237. Rhyacophila yamanakensis Iwata:

235 — full-grown larva; 236 — mandibles, dorsal; 237 — pronotum, propleuron and base of forecoxa.

Distal episternal sclerite of prothorax light yellow; trochantin light yellow, with a narrow reddish brown border; distal seta strong, reddish brown; light, thin setules situated on a membrane anteriorly (Figure 237).

The rodlike sclerites of the pleura of meso- and metathorax are situated obliquely; the longitudinal sclerite is thinner and longer than the transverse sclerite; episternal seta small and reddish, situated in the basal third of the plate; seta of epimeron situated on a membrane little marked. Anterior part of the corner of each segment with a single, light, sausage-shaped gill directed upward and slightly posteriorly.

All three pairs of legs of similar form; forelegs not more massive than mid- and hind legs; hind legs slightly longer than forelegs; legs yellow, partly light yellow or whitish.

Forecoxa short, with a deep dorsodistal notch; its basal margin with a dark border anteriorly and dorsally; anterodorsal margin of sclerite also slightly dark, a small red spot near the articulation with the trochanter. 241 Anterodorsal setae reddish brown, strong; basal seta twice as long as distal seta; posterodorsal seta light, thinner and shorter than the basal seta (Figure 237); both anterior setae small, spinelike, brownish, situated subdorsally; ventrodistal setae small, thin, yellow; posterior seta slightly longer than anterior seta .

Trochanter with a basal dark margin and a brown ventral spot. Anterior seta reddish brown, long; posterior seta lighter, thinner, slightly shorter; ventral subapical seta also long; the other 4 ventral setae small and thin; middle ventral seta darker and slightly longer than the others; distoventral seta curved anteriorly and light.

The posteriorly directed distodorsal seta of the femur is long and reddish brown, the basal upward projecting seta yellow and shorter; anterior seta short, strong, dark brown; posterior seta longer, lighter and thinner; anteroventral seta situated on a membrane at the base, transparent, small and curved anteriorly; posterior seta situated more distally, long and thin.

The anterodorsal seta of the 6 distal setae of the tibia is situated subapically; it is slightly shorter than the thin and long posterodorsal seta; anterior surface seta brownish, shorter and stronger than the light posterior seta which resembles the dorsal setae; the posterior seta of the 2 short distoventral setae is longer than the anterior short seta of the tibia. All 4 tarsal setae are thin, light and of about the same length. The claw is curved, dark brown; the basal seta forms a large pointed spine.

The anterior basodorsal seta on the coxae of the mid- and hind legs, unlike on the forelegs, is short, light and thin; the distodorsal long seta is brown, situated near the basal margin of the distodorsal depression; posterodorsal seta short, light, slightly longer on the hind legs than on the midlegs; both anterior setae spinelike, lighter than on the forelegs; both distoventral setae small and light.

Anterior and posterior setae of trochanter thin and light and long; anterior seta slightly longer than posterior seta; subapical ventral seta also light but slightly longer; the other ventral setae are as on the forelegs.

Anterior seta of the femur (unlike that of the forelegs) longer than the posterior seta, thin and light brown; the other setae as on the forelegs.

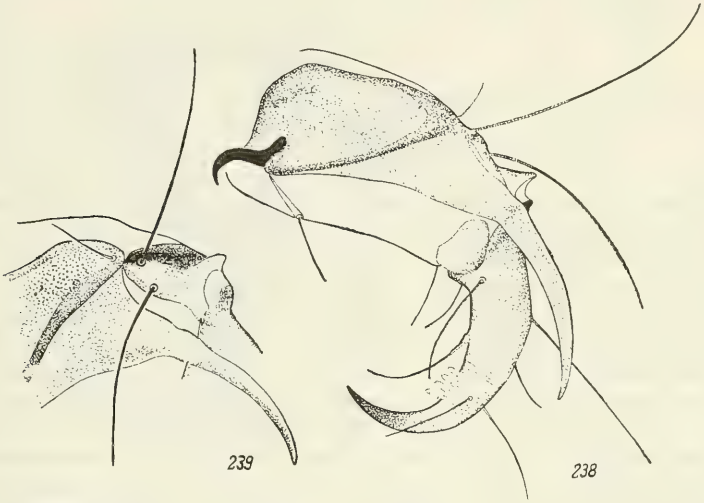
Tarsus narrow, as long as the tibia; setae of the tibia are markedly longer than those of the forelegs; setae of the tarsus slightly longer; all setae are thin, as on the forelegs.

Claw and its spinelike seta slightly longer than on the forelegs.

Abdomen slightly compressed dorsoventrally; uniformly broad on segments 2—4; it tapers posteriorly gradually; tracheal gills absent. Setae thin and light. The small anterior-margin seta is clearly marked; it is slightly longer on the last segments; the anterior-angle seta is about as long as the segment in the anterior segments; it is slightly-longer on the posterior segments; medioanal seta shorter than anterior angle seta; intermediate seta and especially lateral setae small and little-marked; all 4 setae on segment 8 form one row on a narrow, grayish membranous stripe.

Dorsal sclerite of segment 9 mainly reddish brown, with a broad blackish brown anterior margin and blackish brown anterior-angle processes which cover the sides of the sclerite and partly its ventral side; lateral margin concave; posterior margin with a deep median notch lateral to which are the large whitish yellow, weakly sclerotized lobes of the posterior-angle region; 4 setae are present near the posterior margin of the lobes: long brown medioanal setae, an anterior-angle seta and between them a small, thin, light, intermediate and a lateral seta; a narrow reddish brown stripe at the base of the medioanal seta.

(242)



FIGURES 238 and 239. Rhyacophila yamanakensis Iwata:

238 — left anal leg, outer view; 239 — part of left anal leg, outer and slightly dorsal view (base of claw).

Anal legs (Figures 238 and 239) are moderately long. Dorsolateral sclerite "b" yellow, with a broad reddish brown basal and median margin; basal hook with a weakly curved, reddish end; ventral seta straight, light, situated on a narrow brownish sclerite; there is a clearly marked oblique groove which extends from the basoventral angle of the sclerite to the distoventral angle; the short dorsal groove perpendicular to it is absent; lateral margin of sclerite distally with a narrow sword-shaped process of slightly different form from that in Rhyacophila s. str.; it is slightly bulb-shaped at the base. The dorsal tubercle in the posterior part of the distal part of the sclerite has a dark rounded apex; unlike in species of Rhyacophila s. str., both setae of the distal part are equally long; the seta of the dorsodistal angle of the basal part of the sclerite is short. The seta of the small ventral sclerite "c" is short and light; as in Rhyacophila s. str., the lateral sclerite "c" is contiguous with the base of the sword-shaped process at one point.

The claw (Figure 238) is slightly longer than in Rhyacophila s. str;
242 its distal part has 4 larger ventral spinules; seta 1 in the basal part is dark and long, almost 4 times as long as the short thin seta 2; seta 5

reddish brown, strong and long; the median seta 4 is very thin, light and long, the ventral seta 8 is curved and transparent as in Rhyacophila s. str., situated on a small tubercle; seta 7 shorter and thinner than seta 8, also light and slightly curved; dorsal seta 3 and the outer seta 6 in the distal part of the claw are equally long, thin and dark; both are much shorter than seta 1.

The larva of Rh. yamanakensis was briefly described from Japan by Iwata (1, 1927a:205, Figures 28–30).

Mode of life and habitats. Shallow, small mountain brooks with cool water and a stony bottom.

Distribution. In the USSR: Altai. Also Japan.

### 3. **Rhyacophila impar** Martynov

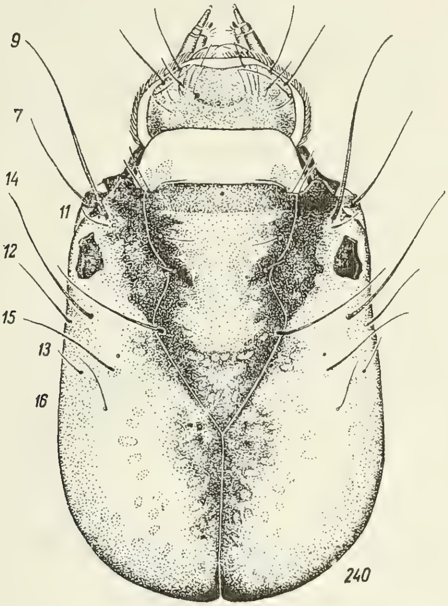
Lepneva, 1949:162–163, Figures 1–3.

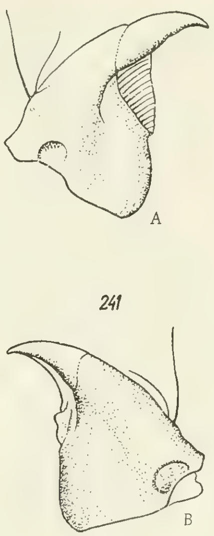
**Full-grown larva.** Length 18 mm. Length of prepupa taken from the case 13.1 mm. Head (Figure 240) relatively small; like the pronotum, it is much narrower than the meso- and metathorax. Head yellow, in some places yellowish brown; pattern distinct; occipital foramen with a narrow dark margin. Frontoclypeus dark in the posterior part and at the sides; dots of the posterior curved row light. The dark dorsal stripes along the frontal sutures and along the coronal suture together with the dark margin of the frontal sclerite form a V-shaped figure; dorsal stripes with large, light dots; lateral stripes absent and replaced by a few indistinct dots; a narrow dark stripe along the gular suture. Lateral and intermediate anterior-margin setae light and small; the former are situated lateral to the frontal suture; the latter are straight, strong and slightly longer; the median seta is yellowish, long and recumbent. Anterior frontal seta similar, curved to the sclerite; middle seta small, light; posterior frontal seta dark and long. Seta 9 situated anterior to the eye, near the anterior margin; it is dark and longer than the other setae of the head; the small and thin seta 11 is situated slightly posteriorly; seta 7 situated at the margin and shorter than seta 9; seta 14 situated posterior to the eye; it is dark and almost as long as seta 9; seta 12 is situated nearby; it is shorter and thinner; seta 15 thin and long; seta 16 situated posterior to seta 15 and much shorter; it is
243 light yellowish; seta 13 situated lateral to the two above setae; it is curved toward the sclerite and directed inward.

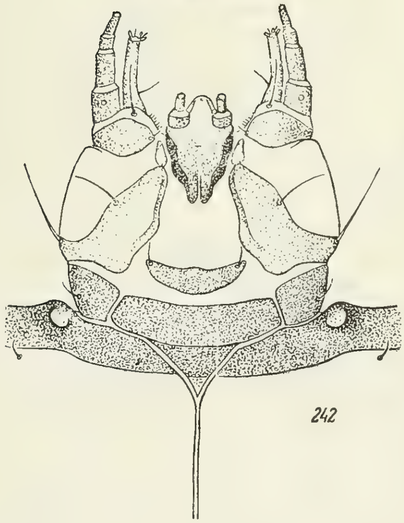
Anterior and lateral parts of labrum broadly membranous, with short white hairs; anterior margin of membranous part straight; dorsal sclerite golden yellow, with a shallow median notch at the anterior margin; posterior-angle sclerites reddish. Seta 1 relatively long and transparent, slightly yellowish, curved inward, situated at the membranous margin; seta 4 also transparent and straight, situated lateral to the medial depression of the sclerite; seta 2 situated near the anterior margin; seta 5 situated laterally, in the anterior-angle part of the sclerite; both setae brown, strong and relatively long; seta 3 situated posterior to seta 5, transparent, thin and recumbent; seta 6 situated more medially, small and brown.

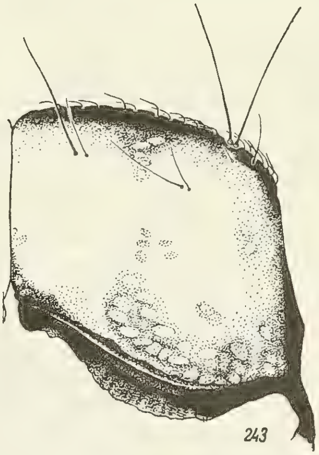
Mandibles (Figure 241) short and massive; upper blade of the mandibles (like in Rhyacophila s. str.) smooth and without teeth; lower blade of the left mandible without teeth; right mandible with a small, blunt, basal tooth. Outer setae of mandibles situated nearby; basal seta longer, straight and dark, distal seta shorter, light and curved.

(244)









FIGURES 240—243. Rhyacophila impar Mart.:

240 — head, dorsal; 241 — mandibles, dorsal: left (A) and right mandible (B); 242 — anterior margin of head, ventral, gula, pregula and maxillolabium; 243 — pronotum.

Maxillolabium (Figure 242), labrum and mandibles resemble those of species of Rhyacophila s. str.; gula, pregula, submentum and cardo brown and of the same form as in species of Rhyacophila s. str.; seta of submentum light, situated near the anterior angles of the sclerite; seta of cardo small and thin; stipes yellow, broad in the middle; the setae are thin, brownish; basal seta slightly longer than distal seta. Palpiger, maxillary palps and galea as in Rhyacophila s. str.; distal seta of palpiger situated on a membrane, brown, thin, reaching the middle of the galea; basomedian seta small, light and thin. Mentum brown; the median suture distinct only in the basal part; anterior margin with a small median notch; ventral sclerites in form of dots; their setae are light and thin; sclerites of labial palpiger broadly sickle-shaped, yellow; palps short.

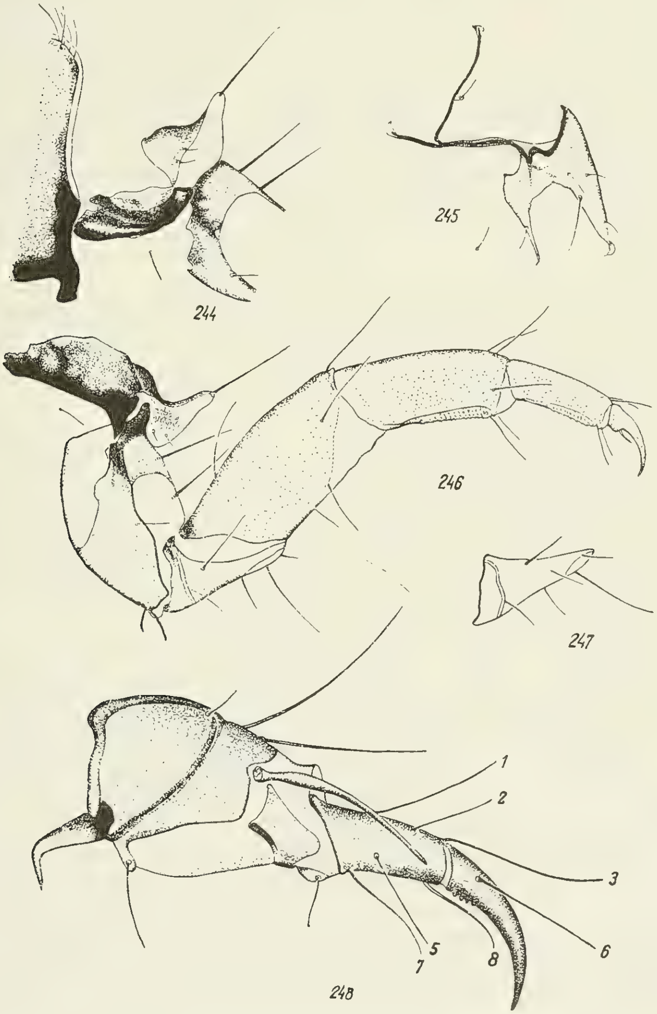
Pronotum (Figure 243) of characteristic form; it is short in the middle so that the posterior margin of each half is situated obliquely to the anterior margin. Anterior margin brown; the deep membranous notch near the anterior angle, which is characteristic for Rhyacophila, is absent; it is replaced by a small curve of the anterior margin; anterior angle of the sclerite dark brown; lateral margin reddish brown in the anterior third; the other part has a black border which is broad in the posterior third; posterior angles black; posterior margin broadly black in the middle and on the sides, brown in the middle of each half, with broad processes; these processes do not project posteriorly as much as in Rhyacophila s. str. The greater part of the sclerite is yellow; it is brownish posteriorly and on the sides; dots present along the median suture and on the sides of the posterior part; several indistinct dots near the anterior margin of the sclerite. Small convex sclerotized dots in the depression of the curve of the anterior margin bear 2 long black anterior-angle setae, a primary seta and a secondary seta; third seta short, brownish, situated lateral to the curve, on the dark margin of the anterior angle; short inward-curved yellow setae at the anterior margin, beginning from the angle; the setae are small and denser lateral to this curve. All surface setae are situated in the anterior part of the sclerite; there is a dark long seta in the middle; and a short light seta slightly more laterally; lateral to the anterior-margin dots is a thin, inward-directed long yellow seta, and nearby a similar short seta; anterior-angle region with several sparse, light, small setae; lateral margin and the adjacent area without setae.

Mesothorax is heart-shaped, larger than metathorax, similar in form to the following abdominal segments; the anterior-margin seta of the mesonotum is, as usual, longer than that of the metanotum and dark; anterior-angle seta situated on a small process; near it, a thin secondary anterior-angle seta which is slightly shorter than the primary seta; medioanal seta as long as the primary anterior-angle seta; intermediate and lateral setae small and thin, well marked. Anterior-margin seta of metanotum small; other setae as on the mesonotum.

The episternum of the prothorax (Figures 244, 246) is brown, dark brown at the base area of the pleural suture dark, partly black; trochantin broad at the base; seta on the membranous apex of the horn-shaped process strong, reddish black; setules situated behind each other and light.

The rodlike sclerites of the pleuron of meso- and metathorax are narrow (Figure 245); the transverse sclerite is short and broader than the oblong longitudinal plate which is slightly oblique, at an acute angle to the transverse sclerite; episternal seta yellowish, situated near the sclerite; epimeral seta small, situated on a membrane posterior to the sclerite, near the posterior margin of the segment. In the angle formed by the sclerites, anterior to the transverse sclerite and lateral to the longitudinal sclerite, is a club-shaped tubercle with a bifid apex; its position and form resemble those at the base of the gills of species of Rhyacophila s. str.

245 Forelegs thicker than mid- and hind legs; midlegs very thin, almost as long as the forelegs; hind legs slightly longer; forelegs brownish; mid- and hind legs yellow.



FIGURES 244–248. Rhyacophila impar Mart.:

244 — right margin of pronotum, propleuron and base of coxa of foreleg, lateral; 245 — mesopleuron and coxa of midleg, dorsal; 246 — right foreleg (posterior view) and propleuron; 247 — trochanter of left foreleg (anterior view); 248 — left anal leg (outer view).

Coxa of foreleg (Figure 246) dark brown at the base (in its posterior part also basodorsally); anterodorsal setae black, moderately long, strong, of the same length; one situated near the margin of the notch and the other further basally; posterodorsal seta shorter and thinner, dark brown; anterior surface setae small, brown, situated subdorsally, one behind the
246 other; distoventral setae brown; the anterior small seta is situated ventrally; posterior seta slightly longer. Distal part of trochanter with a longitudinal membranous area (Figure 247); anterior seta dark brown, short and strong; posterior seta brown, longer and thinner than the anterior seta; ventral setae light brown; both posterior setae are situated on a membrane; the subapical seta is long; the more basal seta is short; the 3 anteroventral setae are situated on a sclerite; they are small and strong; distal seta curved, situated on the suture and thinner than the others.

The femur is membranous ventrally; its basal part with a narrow stripe; the membrane between the sclerites is thick, covered with needle-shaped spinules arranged in groups. The distodorsal seta is long, the basal seta shorter; the anterior and posterior setae are situated subapically; posterior and posteroventral seta long, dark brown; anterior seta black, shorter and stronger than the posterior seta; anteroventral seta spinelike, yellowish, situated on a membrane near the distal end of the row of spinules.

Posterior distodorsal seta of the tibia shorter than the distodorsal seta of the femur; anterodorsal seta thin and situated subapically; anterior and posterior setae and both ventral setae short and strong; distal setae of tarsus short and thin. Claw slightly curved and pointed, with a spinelike thick, light, pointed seta.

Coxae of midlegs and hind legs longer and narrower than those of the forelegs; they are milk-white ventrally, not sclerotized, with a thick integument; basodorsal anterior seta short, thin and brown; distal seta long, dark brown, longer than that of the forelegs; posterodorsal seta short and dark; both anterior surface setae situated subdorsally; the seta situated further basally is thinner and shorter than the subapical seta; the distoventral setae are situated on a membrane; they are small, brown and thin; posterior seta longer than the anterior seta.

The trochanter is broadly membranous ventrally; the anterior and posterior setae of the midlegs are of the same length; anterior seta of the hind legs larger than the posterior seta; subapical seta of the posteroventral setae of the trochanter, long, the second short, situated on a membrane; the basal seta of the 3 small anterior setae is situated on a suture, the distal and middle setae (unlike on the forelegs) are situated on a membrane near the margin of the sclerite.

Femur of midlegs basoventrally with a row of minute spinules which are absent on the hind legs; distodorsal seta of the femur of both legs long, dark brown; basodorsal seta short, thinner and brown; anterior and posterior setae situated subapically, almost of the same length; posteroventral seta similar; anteroventral seta situated in the basal part, light brown, spinelike; it is situated at the end of the row of spinules on the midlegs.

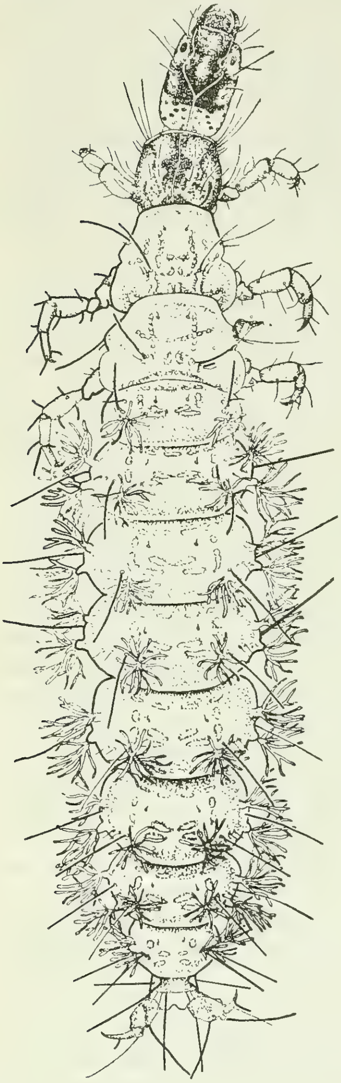
The posterodorsal seta of the tibia is situated distally; it is longer than the others; the anterodorsal seta is situated subapically and is shorter and thin; anterior and posterior seta almost of the same length; ventral setae shorter; all setae dark brown. Tarsus of hind legs longer and much thinner than tibia; tarsus of the midlegs not so long; all 4 setae are short, thin, brown, of almost the same length. Basal seta of the claw of the midlegs as on the forelegs but shorter; basal seta of the claw of the hind legs very short, in form of a small spinule which is thick at the base.

Abdominal setae blackish brown or brown. The anterior-margin seta on abdominal segments 1—8 is small; anterior-angle seta is small, shorter than the medioanal seta; secondary anterior-angle seta very small, usually hardly marked; intermediate and lateral setae situated close nearby at some distance from the medioanal seta; intermediate seta slightly longer than the lateral seta; the anterior-angle seta on the 8th segment is displaced to the middle of the segment.

The dorsal sclerite of segment 9 is of a characteristic form, with a broad median notch on the posterior margin, concave sides and large lateral and posteriorly-directed lobes of the posterior angle; the sclerite has a dark brown anterior margin which is lighter in the middle; it extends also to the long ribbon-shaped anterior-angle processes which surround the segment laterally and partly ventrally. Anterior-angle setae small, reddish yellow and situated posterior to the margin; 4 setae near the posterior margin of the lobes: a long black anterior-angle seta on a process of the posterior angle of the sclerite, and a short dark seta; medioanal seta strong; at some distance from it there is a similar short but thin intermediate and lateral seta which are situated closer to the angle seta.

The anal legs (Figure 248) differ markedly from those of the group Rhyacophila s. str. Part "b" is short; the dorsolateral sclerite of part "b" is brownish yellow, with a broad, blackish brown median and basal border; the basoventral hook of the sclerite is differentiated sclerite with a long black basal part and a curved red end which enters into the notch of the basoventral angle of the sclerite; the ventral plate near the hook is triangular, with a straight, light short seta. The oblique groove of the dorsolateral sclerite runs from the base of the basoventral hook to the subapical point of the dorsal median margin of the sclerite, dividing the
247 sclerite into two unequal parts, an anterior and a posterior part. The groove perpendicular to the oblique groove is absent. The posterolateral margin of the sclerite forms a rounded, broad process which is directed posteriorly; dorsal to this process in the curve formed by the margin, a small round sclerite with a long curved sword-shaped process. This process is thus not a distal process of sclerite "b," as in Rhyacophila s. str., but a separate sclerite; unlike the true sword-shaped process of Rhyacophila s. str., the "spurious sword-shaped" process of the anal leg of Rh. impar is rodlike, irregularly cylindrical; its cross section is round; it is bluntly pointed posteriorly. The dorsodistal part of sclerite "b" has a black median border and a dark groove; the distal tubercle is a high, posteriorly open fold on the margin of the sclerite which is without a complete apex, and is well marked in species of Rhyacophila s. str. but hardly marked in this species. Lateral to this groove are two setae one behind the other; unlike full-grown larvae of Rhyacophila s. str., both setae are long, as in the young larvae of the

above group; as in Rhyacophila s. str., the distodorsal seta of the basal part of the sclerite is short and thin. Ventral plate of sclerite "c" small, yellowish brown, with a short light seta; the lateral sclerite "c" is wide and rhomboidal, with a dark ventral margin and a concave basal margin the angles of which rest on the apex of the process of the posterior margin of sclerite "b" and on the base of the sword-shaped process.



248

FIGURE 249. Rhyacophila hokkaidensis Iwata. Full-grown larva, dorsal

Claw (Figure 248) long and narrow, resembling the claw of species of Hyporhyacophila; all setae are more or less long, seta 1 on the dorsal side of the basal part longer and thicker than seta 2; the outer seta 5 is also long and strong, situated closer to the base of the claw; median seta 4 situated near the margin of the transverse membranous fold, near the curved light ventral seta 8; seta 7 near the base of the claw as long as seta 8; the dorsal side of the distal part of the claw with seta 3 near the transverse membranous fold; seta 6 situated on the outer side, slightly more distally; both setae strong, dark and long.

Mode of life and habitats. Small mountain brooks and rivulets, clean channels of lakes (Teplovsl Channel near Khabarovsk).

Distribution. USSR: Altai, Sayans, East Siberia, Far East.

## 5. Group Paleorhyacophila Lepneva

Lepneva, 1963:68.

**Full-grown larva.** Length 16.5–19.0 mm. Head oblong, with a dark dorsal pattern and with indistinct spots ventrally; left mandible without teeth; right mandible with 2 distal teeth; a small toothlike process at the base of the distal part of the blade. Pronotum with a dark figure in the middle. Thoracic gills absent; abdominal gills tufted, present on segments 1–8. Sclerite "b" of the anal legs without sword-shaped process.

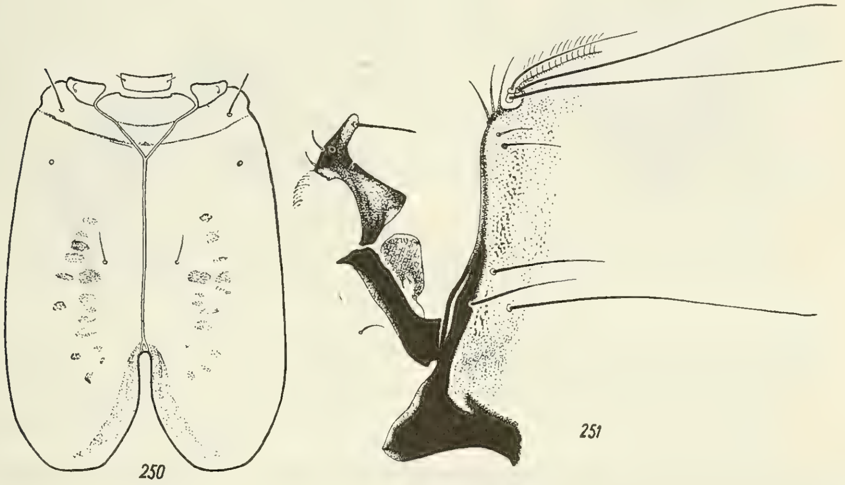
Mode of life and habitats. Brooks, including mountain brooks with a stony bottom and a low temperature.

Distribution. USSR: Sakhalin, probably also in the Maritime Territory. In addition, Japan, North America.

### 1. Rhyacophila hokkaidensis Iwata

Iwata, 1927a:203–204, Figure A, 2, 18–25.

**Full-grown larva** (Figure 249). Length 18–19 mm. Head oblong, yellowish; frontoclypeus dark in the anterior part and laterally, light in the middle of the posterior part; posterior angle with two large dark dots; dorsal stripes well marked from the anterior margin, narrow in the anterior part; they are broader posteriorly, extending to the bifurcation of the frontal suture; lateral stripes absent, replaced by dark dots; the space between the stripes light or slightly dark. Ventral side of head light (Figure 250); each half with groups of 2–3 distinct dots and several indistinct dots lateral to seta 8.



FIGURES 250 and 251. Rhyacophila hokkaidensis Iwata:

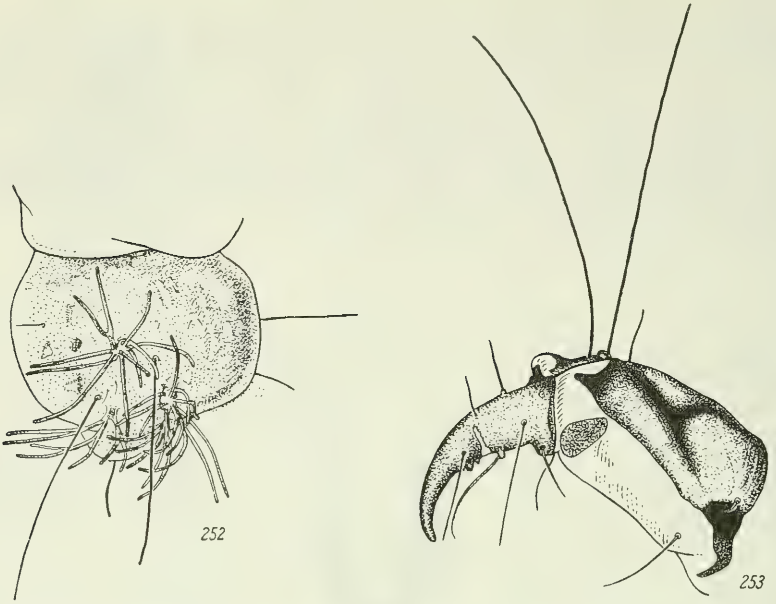
250 — head, ventral; 251 — left margin of pronotum and propleuron.

The left mandible without teeth; lower blade finely serrated; right mandible with two teeth in distal part; the basal tooth of distal part forms a small process.

Pronotum (Figures 249, 251) with a broad dark posterior margin; lateral margin narrowly black in the posterior half; there is a dark figure which is broader in the middle in the anterior part; the anterior part bears a curved row of dots lateral to the figure; posterior part with groups of dots; the primary anterior-angle seta and one of the secondary anterior-angle setae long; 2nd secondary seta thinner, moderately long and well developed. The primary anterior-angle and the medioanal setae of the meso- and metanotum are thin and long, as on the abdominal segments.

Propleuron (Figure 251) with a broad pleural suture; the epimeron forms a narrow brownish stripe close to the suture; the seta is small, situated on a membrane; episternum brownish; trochantin oblong, not fused with the episternum and darker; the seta is short, black, situated at the apex of the distal process; both setules are situated on the outer side; the trochantin of the meso- and metathorax is also free, with a small dark seta.

249



FIGURES 252 and 253. Rhyacophila hokkaidensis Iwata:

252 — abdominal segment, lateral; 253 — right anal leg, outer view.

Forelegs slightly thicker and shorter than midlegs and hind legs; the large setae are short, strong and black.

Gills tufted; their stem is slightly longer than in Rhyacophila s. str.; unlike in the preceding groups, the gills are situated dorsally, one tuft on abdominal segment 1, three tufts on segments 2—7, one median tuft and two lateral tufts; segment 8 with only two tufts (Figures 249, 252); the median tuft of segments 1—7 is situated posterior to the laterally displaced medioanal seta; the lateral tufts of segments 2—8 are situated anteriorly and posteriorly, near the base of the anterior-angle seta, on the boundary with the pleural region. Dorsal sclerite of segment 9 reddish brown, lighter in the middle than laterally; medioanal and anterior-angle setae black and strong; there are two long setae, one on a light spot at the margin of the sclerite and the second on a membrane near the sharp posterior angle of the sclerite; intermediate and lateral setae small, thin, situated near the margin of the sclerite.

Anal legs relatively short (Figure 253); grooves of sclerite "b" blackish; basoventral hook massive, black, slightly curved; ventral seta near the base of the hook thin and situated on a sclerotized dot; a sword-shaped process absent, replaced by a small dark process; both setae on the distal part of the sclerite black, of the same length; distal seta of the basal part short and strong; seta of the median sclerite of section "c" small and dark.

The claw is equally well developed in the basal and distal parts; distal part with two blunt ventral spinules; setae 5, 6 and 8 longer than the others; seta 1 strong, black; seta 2 short and thin; seta 3 moderately long, curved toward the distal side; seta 8 transparent, situated on a small tubercle, longer than seta 7.

Mode of life and habitats. Mountain brooks, on stones.

Distribution. USSR: Sakhalin, probably also in the Maritime Territory. In addition: Japan.

## 6. Group Prosrhyacophila Döhler

Döhler, 1950:272, 274.

**Full-grown larva.** Length 9–14 mm; body flattened; head relatively broad. Distal end of right mandible divided; basal tooth of lower blade large and blunt; submentum broad, almost square. Thoracic gills absent. Abdominal gills present on segments 1–8 or 2–8 in form of single fingerlike processes which are broader at the base. Anal legs without sword-shaped process; all 8 setae of the claw long. Larvae of two species are known, a European and a Siberian species; these larvae differ markedly from each other.

250 Mode of life and habitats. Cool brooks, on stony bottom.

Distribution. USSR: Carpathians (?), Altai, Sayans, Maritime Territory. In addition: southern and Central Europe.

### Key to Species

Full-grown larva

1 (2). Fingerlike gills longer than the segment; ventral tubercle at base of gills absent; claw of anal legs without small ventral claws. Europe . . . . . . . . . . . . . . . . . 2. **Rhyacophila laevis** Pict. (p. 271)
2 (1). Fingerlike gills shorter than segment, with a ventral tubercle at the base; claw of anal legs with small ventral claws. Asia . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Rhyacophila retracta** Mart.

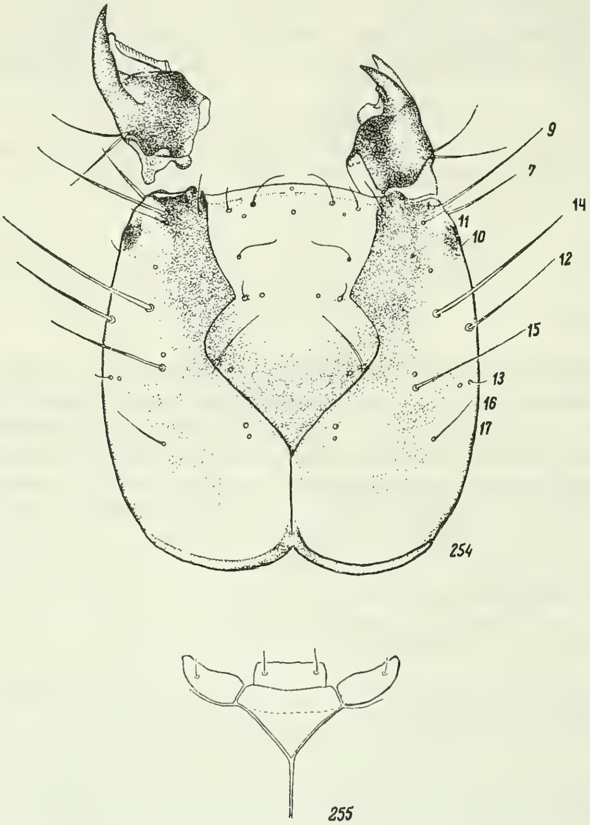
### 1. **Rhyacophila retracta** Martynov

Lepneva, 1949:166–167, Figures 11–14.

**Full-grown larva.** Length 14.0–14.2 mm; sclerotized areas reddish yellow; pattern brown or blackish brown. Length of head 1.4 mm, width 1.2 mm (Figure 254). Frontoclypeus light, reddish brown anteriorly, the dark heart-shaped figure occupies almost the whole posterior part of the sclerite; it bears a curved row of four transverse dots behind the curve of the frontal sutures. Laterally, anterior to the posterior frontal setae, there are 3 more small, oblong light dots. Frontal setae black; the middle and anterior setae are small, setuliform; the anterior seta situated some distance from the margin of the sclerite, opposite the middle seta; the

3 anterior marginal setae are small and light. The sclerite has a broad, dark brown margin along the frontal sutures which continues as a narrow stripe along the coronal suture (Figure 254); the lateral stripe of the head is curved, narrow, adjacent to the dorsal stripe near the base of the coronal suture; there is a large light spot between the stripes in the posterior part of the head; this spot is connected anteriorly in the area of seta 15. The head is light anteriorly and the eyes are situated on a white area; seta 9 is the longest seta of the head and is situated medial to the eyes; the small light seta 11 stands nearby; seta 7 is dark, shorter than seta 9; seta 10 is situated lateral to the eye; it is transparent and light; setae 14 and 12 are situated behind the eye; they are brown and strong; seta 15 short, brown and strong; seta 16 shorter; setae 17 small, thin, light, situated laterally at the level of the bifurcation of the frontal sutures. Head yellowish red ventrally, with indistinct light dots in the posterior part; gula brown and small (Figure 255); setae 8 spinelike; setae 18 small; occipital foramen with a narrow dark border.

(251)

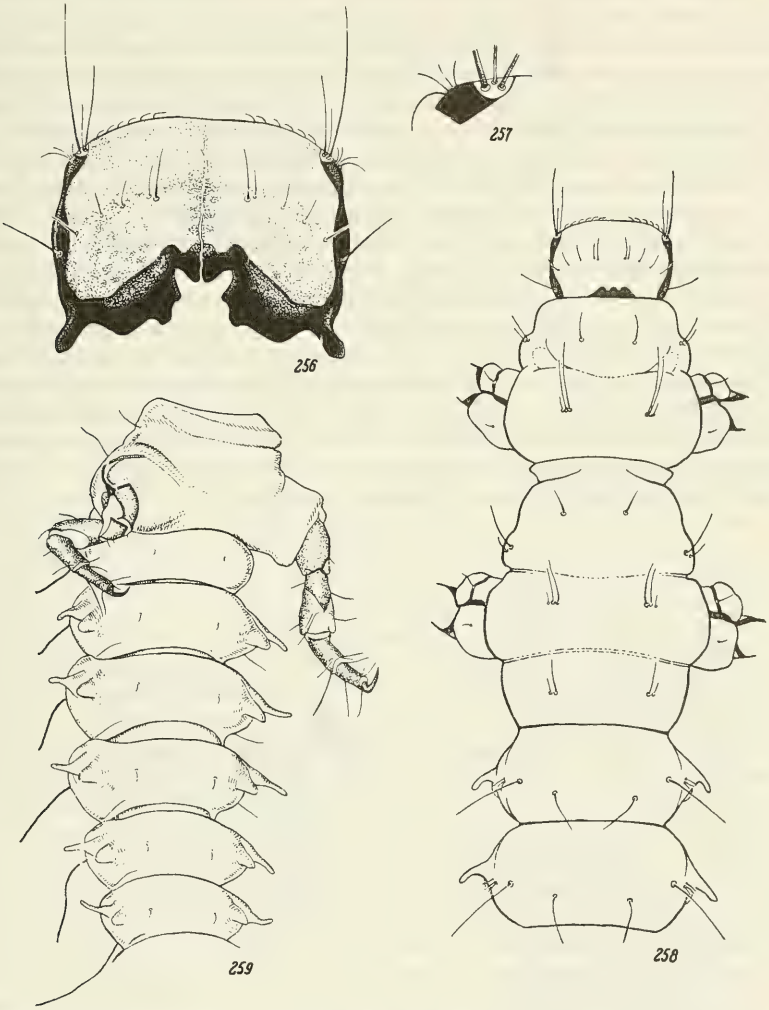


FIGURES 254 and 255. Rhyacophila retracta Mart.:

254 — head and mandibles, dorsal; 255 — gula, pregula, submentum and sclerites of cardo.

Labrum broad, relatively short; dorsal sclerite light yellow and thin; its membranous margin narrow and white, with short hairs; the transparent seta 1 relatively long, distinct; seta 4 only slightly longer, brownish yellow; setae 2 and 5 thin and straight; seta 3 light, curved; seta 6 projecting far laterally.

(252)



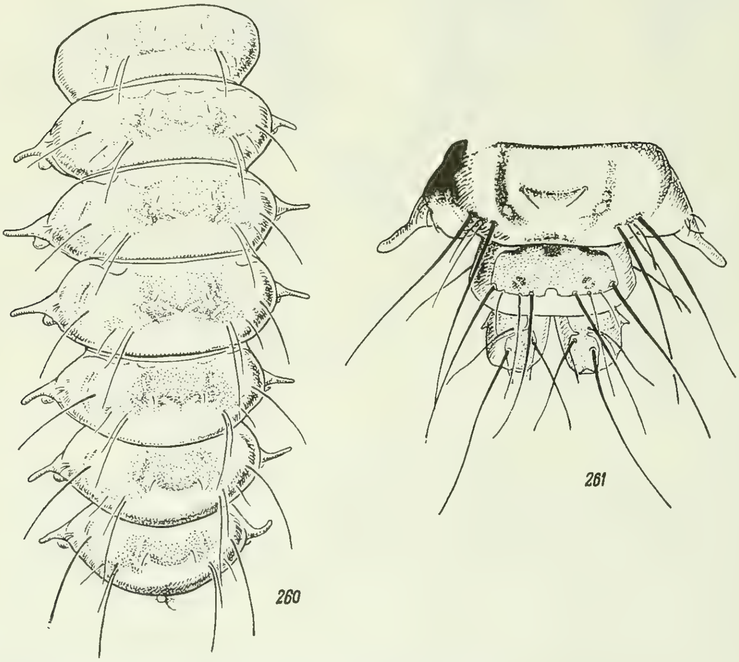
FIGURES 256–259. Rhyacophila retracta Mart.:

256 — pronotum; 257 — base of left anterior-angle setae of pronotum; 258 — thorax, abdominal segments 1–3, dorsal; 259 — metathorax and abdominal segments 1–6, ventral.

Mandibles brown (Figure 254); upper blade of left mandible without teeth; serrated part of lower blade projecting, with apical and basal processes; distal end of right mandible divided; basal tooth of lower blade blunt, trapezoidal and large; one seta of the mandibles light, curved, second seta straight and dark brown. Pregula fused with the gula and dark brown like the cardo; seta of cardo short; submentum (Figure 255) with an almost straight anterior margin; lateral margins slightly concave; posterior angles rounded; seta short, situated at the side of the sclerite near the anterior angle; sclerite of stipes yellow; basal seta thin, light yellow and long; apical seta shorter and thinner.

Pronotum (Figure 256) reddish yellow; posteriorly, near the median punctate figure and the dots it is darker laterally; a narrow brown stripe near the anterior margin; the broad posterior margin is uniformly black, without light intervals, with a deep notch in the middle and wide, black, posterior processes; posterior angles long and black; lateral margin broadly black; in its greater part it has a dark brown border in the anterior quarter. Anterior angle with a large black spot (Figure 257) and with 4 light small setae; the light notch nearby is visible as a small white spot; it bears a dark, relatively long primary anterior-angle seta and 2 secondary setae; one of them is dark, moderately long and situated near the primary seta; the second is situated anterior to it; it is short and light; there are small, sparse, yellow, curved setae at the anterior margin. Pronotum with a row of 4 setae in about mid-length of the sclerite; the median seta is long and dark, the next is short, light, situated near the median seta, the other 2 are also thin and light and situated at a
251 distance from each other and from the former 2 setae; the black lateral margin of the sclerite bears a strong, brown relatively long seta; there is a similar dark, short seta a short distance from the margin.

(253)



FIGURES 260 and 261. Rhyacophila retracta Mart.:

260 — abdominal segments 1–7, dorsal; 161 — abdominal segments 8 and 9 and part of the anal legs, dorsal.

Meso- and metathorax are almost twice as long as the prothorax and markedly broader (Figure 258); both segments are divided into an anterior and posterior part by a light transverse groove; they are covered with light dashes and dots. Anterior-margin seta of mesonotum large, reddish brown, that of the metanotum dark, but small and thin; the primary anterior-angle setae of both segments are dark and relatively large; nearby stands a small, light secondary seta; medioanal seta of mesonotum larger than the anterior-angle seta, that of metanotum smaller; nearby is a thin light intermediate seta; the lateral seta is small and not always present.

The pleuron of prothorax reddish yellow in the episternal region, which is separated by a deep, narrow, membranous notch from the black sclerite; epimeral seta situated on a membrane small, reddish brown; trochantin brown; its distal seta strong and black. There are two black pleural sclerites on the meso- and metathorax (as in the whole genus Rhyacophila): a longitudinal sclerite with a small seta and a transverse sclerite which extends to the articular process of the coxa; epimeral seta situated on a membrane, small and reddish brown (Figure 258).

252 Legs (Figure 259) brown, short, differing little in length; forelegs more massive than the others. Form, size and arrangement of the setae of the legs exactly as in Rhyacophila s. str. but the setae are thinner. Claws more curved and pointed.

Abdominal segment 1 (Figures 258 and 259) shorter and slightly narrower than segments 2 and 3; it seems to be connected with the metathorax; segments 2 and 3 are the broadest part of the body; the abdomen tapers gradually from segments 4–7; segment 8 much smaller; segment 9 is small and narrow as usual. The dorsum of the abdomen is
253 brownish in fixed larvae; the light respiratory stripes form a transverse K-shaped figure with minute stripes and spots laterally, and with an intersegmental interrupted row of dashes and dots.

The gills of segments 2–8 (Figures 258–262) form a sucker-shaped tubercle and a gill filament situated slightly more dorsally and anteriorly and divided by a deep fold; the gill filament is conical; it is narrower and slightly curved at the end; the gills of fixed specimens are white. Compared with the gills of Rhyacophila s. str., those of Rh. retracta consist of one filament of the dorsal branch and the stem of the ventral branch without filament.

The anterior-margin and anterior-angle setae are indistinct on the dorsum of the first abdominal segment; intermediate surface seta shorter and thinner than the medioanal seta; lateral seta small; anterior-margin setae on the dorsum of segments 2–7 small, light and distinguished with difficulty;* anterior-angle setae relatively large, brown, situated on segments 2–5 in about midlength; they are displaced posteriorly on segments 6–7; medioanal seta almost as long as the anterior-angle seta; intermediate seta shorter and thinner; lateral surface seta small; it is situated on the anterior segments at a distance from the other two setae; it stands closer to the other two setae on the posterior segments. Anterior-margin seta of segment 8 longer than on segment 7; the anterior-angle seta stands in a row with the posterior setae near the lateral surface seta which is transparent, straight, markedly longer than

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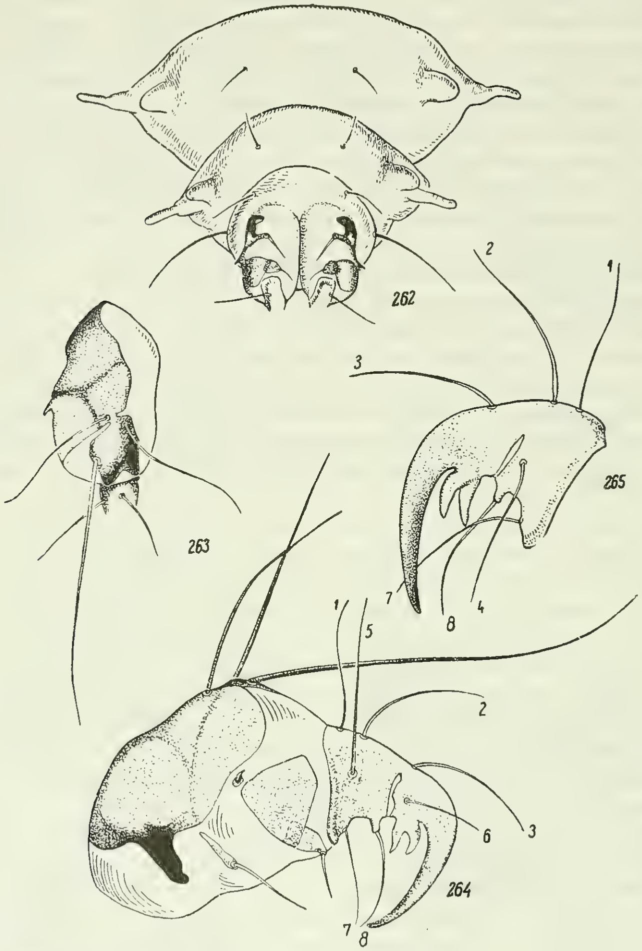
* The small setae are not shown in the figures.

those of the preceding segments; the dark medioanal seta and the thin intermediate seta are long; all 4 setae are situated on a small, transverse yellow sclerite in the posterior part of the segment. In this respect they resemble the setae of the posterior margin of the dorsal sclerite of abdominal segment 9. Pleural setae small, situated at the base of the gill as in Rhyacophila s. str.

254



FIGURES 262–265. Rhyacophila retracta Mart.:

262 – abdominal segments 7–9 and part of the anal legs, ventral; 263 – left anal leg and base of claw, dorsal; 264 – left anal leg, lateral; 265 – claw of left anal leg, inner side.

Posterior margin of dorsal sclerite of segment 9 straight, with a small notch in the middle (Figure 261); anterior angles rounded; the anterior margin has a brownish red border which is broader in the middle; two

large dark spots are present laterally, near the posterior margin. Medioanal setae widely separated; they are long, dark brown and thick; intermediate setae also long but lighter and thinner; lateral setae light, short and thin; anterior-angle setae large and dark. The large lateroventral seta is situated in the pleural region on a small dark brown sclerite; intermediate
255 ventral seta brown, thinner and shorter, medioventral seta small and setuliform.

Anal legs short (Figures 261–264). Dorsolateral sclerite "b" with a broad dark brown basal margin; ventrobasal hook blunt and slightly curved, reddish, with a broad, blackish brown base; ventral sclerite near it small and yellow; the seta on this sclerite light and spinelike. The groove extending from the basoventral to the dorsodistal angle of the basal part of the sclerite is darker than the other part of the surface; the transverse groove perpendicular to the basal groove is clearly marked; a sword-shaped process absent; dorsal seta of the basal part of the sclerite long and strong. Apical part of the sclerite irregularly rhomboidal, broadly black in the middle and brownish in the other part; in Rhyacophila s. str., the mediobasal seta of this part is thin and little marked; in Rh. retracta this seta is dark, strong and long; outer dorsodistal seta dark, thick, and the longest seta of the anal legs. The medioventral sclerite of section "c" is yellow; its seta is spinelike, light and slightly shorter than the ventral seta; the second sclerite of section "c" is larger, extending to the side of the leg; it forms an irregular triangle; a small dark brown, stump-shaped sclerite with a small hook-shaped process (the homologue of the sword-shaped process of the Rh. impar type) near the angle of the sclerite adjacent to the laterodorsal sclerite; this process is wedged between the above sclerite of section "c" and sclerite "b."

Claw strongly curved (Figures 264 and 265); unlike in many species, seta 1 in the basal part of the claw is thinner than seta 2, which is light, thick, strongly curved, resembling seta 2 of the claw of species of Himalopsyche; however, it is longer than this; outer seta of the basal part (seta 5) longer than the transparent, curved ventral setae 7 and 8; seta 8 situated on a tubercle; the mediobasal seta 4 is situated near seta 8; it is the longest and thickest seta of the claw; setae 3 and 6 are situated on the dorsal outer side of the apical part; two large massive spines on a common base are present on the ventral side.

Mode of life and habitats. Mountain brooks and rivulets with cool water and a water temperature of 9–12° in summer; they live in rapid current on the lower surface of stones.

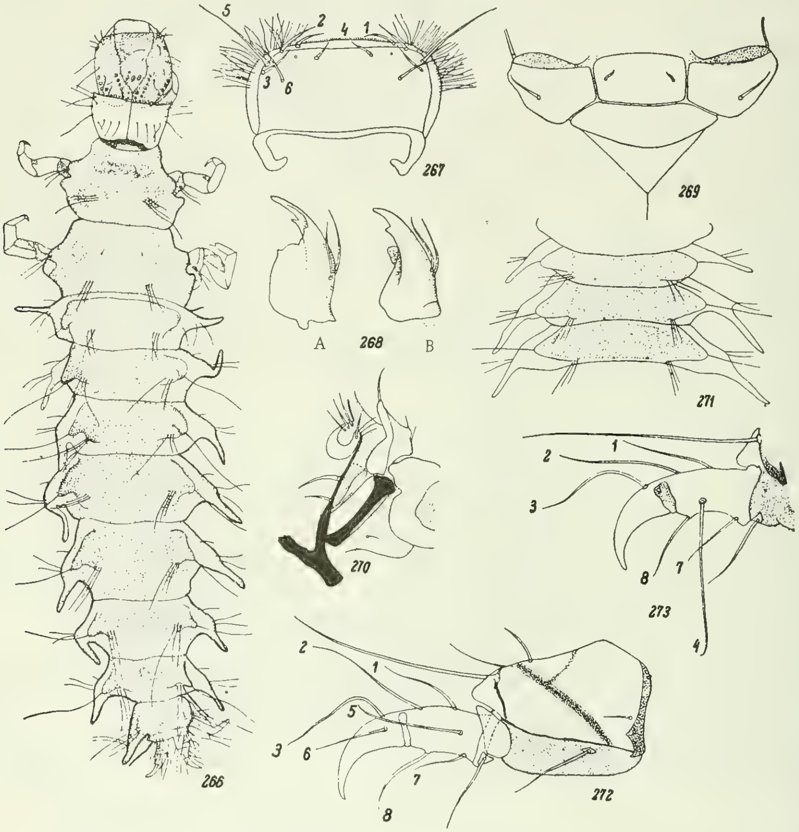
Distribution. USSR: Altai, Maritime Territory. Not recorded outside the USSR.

### 2. **Rhyacophila laevis** Pictet

Thienemann, 1912:250–251, 255–256, Figures 1–5. — Lestage, 1921:418. — Krawany, 1935:245, Figure 2. — Döhler, 1950:286. — Botoşăneanu, 1952b: 895–907, Figures 1–5; 1956c:590–594, Figures 1–3.

**Full-grown larva.** About 10–11 mm long (Figure 266). Head reddish yellow, with a pale, punctate figure; occipital foramen with a narrow blackish brown border. Frontoclypeus with a curved row of indistinct dark dots in the posterior part. Median anterior-margin seta larger than the others; it is curved inward and recumbent; intermediate seta small and light; lateral seta larger, situated lateral to the frontal suture. Anterior frontal seta large and recumbent as in Rh. retracta; middle seta small, the posterior seta slightly longer. Large dots on the sides lateral to the frontal sutures and the coronal suture; the group of anteocular setae is formed by setae 9, 7 and the small and thin seta 11; setae 12 and 14 in the middle and posterior part of the head are situated close together and of almost the same length; setae 15 and 16 are situated behind each other; the small seta 13 is situated lateral to them; seta 17 small, situated near the bifurcation of the frontal suture.

(256)



FIGURES 266—273. Rhyacophila laevis Pict.:

266 — full-grown larva, dorsal; 267 — labrum; 268 — mandibles: left mandible, ventral (A); right mandible, dorsal (B); 269 — gula and base of maxillolabium; 270 — part of pronotum, propleuron and base of coxa of foreleg; 271 — abdominal segments 1—3, dorsal; 272 — right anal leg, outer view; 273 — distal end and claw of left anal leg, inner view (271 — after Thienemann; 266—270, 272—273 — after Botosaneanu).

Labrum (Figure 267) with a narrow membranous stripe anteriorly and laterally; hairs at the sides of the labrum white; dorsal sclerite buff yellow, with slightly concave anterior margin; seta 1 situated on a membrane small, curved and light; seta 2 situated near the margin of the sclerite and slightly larger; the thin seta 4 is situated medially on a sclerite; seta 3 situated laterally and recumbent; seta 5 situated at the anterior angle of the sclerite, large and brownish; seta 6 shorter, situated on the surface, medial to seta 3.

Mandibles (Figure 268) chestnut brown, darker apically. Upper blade of left mandible with one tooth; lower blade of the left mandible with a projecting, finely serrate part with small lateral processes; upper blade of right mandible with a small subapical tooth; lower blade of right mandible with a large basal tooth. Outer setae of mandibles of almost the same length.

Pregula (Figure 269) with straight anterior margin; the sides are oblique; submentum broadly quadrangular, with rounded anterior corners; posterior margin of submentum contiguous with anterior margin of pregula; setae small near the lateral margin and situated in the middle of the sclerite. Sclerites of cardo relatively large, their median margin adjacent to the submentum; part of the posterior margin of the sclerites of the cardo contiguous with the oblique sides of the pregula; the seta is short; unlike in Rhyacophila s. str., it is larger and not smaller than the seta on the submentum. Mentum large; it has no median suture according to
256 Botoşăneanu (1952:898); its anterior margin has a small asymmetrical process; the small ventral sclerites are rhomboidal, with a small light seta.

Pronotum (Figure 270) brownish; angles of the anterior margin with a deep rounded notch; lateral margin of the anterior part with a narrow brown border; posterior third of lateral margin with a broad, black border; posterior angles black; border of posterior margin black in the middle and laterally; brown in the middle of each half, with broad, rounded, posterior processes. There are light short setae at the anterior margin; 3 setae in the anterior-angle depression, a primary and 2 secondary setae; process of anterior angle with 3 small thin setae and one stronger seta; transverse row of 4 setae about midlength of the sclerite; 2 of these setae are long and strong and 2 are short and thin; a short thick seta near the lateral margin of the posterior third, near the end of the broad black border; a larger seta anterior to the latter, at a distance from the margin; the
257 sclerite bears in addition several small thin setae which are mainly situated near the anterior angle.

Propleuron (Figure 270) with a broad, black longitudinal stripe in the middle; this stripe is dark brown in the epimeral and episternal region; dorsal sclerite of episternum yellow and separated from the basal sclerite by a narrow membranous stripe; it is not fused with this at the base, as in species of Rhyacophila s. str., according to Botoşăneanu (1952, Figure 4, A). Trochantin with a long, narrow hornlike process and a short, strong, apical seta; both setae are small and situated on the outer side of the membrane, one behind the other; seta of epimeron small and situated on a membrane.

Forelegs more massive but shorter than the midlegs and hind legs.

Abdominal segments (Figure 271) dorsoventrally compressed; they are reddish, with a pattern of light stripes and spots in alcohol specimens;

the ventral surface of the abdomen is almost flat and whitish. Dorsal side of segments 1—7 with a large, sucker-shaped process; pleural region of these segments with a whitish gill which consists of a long, conical, fingerlike process. The gills of segments 1, 7 and 8 are shorter and thinner than the others. Anterior-angle seta strong and long; it is situated on the dorsal process on segments 1—7; anal surface setae situated on the sides of the segment, posterior to the base of the dorsal process; segment 8 smaller and narrower than segment 7; its dorsal tubercle is absent; the anterior-angle seta and the surface setae of segment 8 are arranged in a row, as on segment 9; the anterior-angle seta is markedly longer than the others. Two small, lateral setae at the base of the gill, at the base of the conical lateral process.

Dorsal sclerite of segment 9 brownish and trapezoidal; its anterior margin shorter than the posterior margin; 4 setae at the sides of the posterior margin, a longer medioanal seta, a short, thin intermediate seta and a short, thin lateral seta, and a larger anterior-angle seta.

Laterodorsal sclerite "b" of anal legs (Figure 272) brown; the dark brown basal margin, the oblique groove and the groove perpendicular to this are well marked; the basoventral hook is absent; there is no distal sword-shaped process; the small, distodorsal part of the sclerite has a dark median stripe; the distal seta of this part is very long, longer than the claw; the seta situated nearby, further basally, is much shorter, but larger than the short dorsal seta of the basal part of the sclerite; ventral seta situated on a small, round sclerite, short and strong. The seta of the small ventral sclerite of section "c" is like the latter seta; the lateral sclerite "c" is much larger than the ventral sclerite.

Claw (Figures 272 and 273) (especially its basal part) long and narrow, unlike in Rh. retracta; seta 1 (unlike that of the higher Rhyacophila) much shorter than seta 2; dorsal seta 3 situated at the base of the distal part of the claw, long, curved and longer than the outer seta 6; inner side of the basal part with the large, strong seta 4, which is the longest seta of the claw; the outer side also bears the long seta 5; ventral side with setae 7 and 8; seta 7 is situated at the base and is short; seta 8 is situated near the membranous transverse stripe; long, and curved; both setae are light.

**Pupa.** Length about 8—9 mm. Labrum with rounded anterior margin; each side with 5 dark setae, as in species of Rhyacophila s. str. Mandibles long, yellowish brown, slightly curved, serrated on the inner side; base of the serrated part of the right and left mandible with 2 teeth. As in other species of Rhyacophila, the natatorial setae are situated on segments 1—4 of the mid-tarsi. According to Thienemann (1912:255), the presegmental plates of the holding apparatus are present on segments 3—7, postsegmental plates on segments 4 and 5; thus, compared with Rhyacophila s. str., there is one additional pair of presegmental sclerites and one pair less of postsegmental sclerites (segment 3).

Mode of life and habitats. Small cool brooks in mountain and spring regions; under stones; phytophagous.

Distribution. Not recorded from the USSR; it probably occurs in Transcarpathia. Mountains in Central and southern Europe.

## 7. Group Hyporhyacophila Döhler

Döhler, 1950:275–276.

**Full-grown larva.** Small or medium sized, 10–18 mm long, of a different habitus than in the groups described above; body uniformly broad in the middle and less flattened. Mandibles massive; upper blades with distal teeth. Dorsal setae of abdomen long. Tracheal gills absent. Anal legs 258 without sword-shaped process on the basal segment; seta 2 of the claw long, sometimes massive.

Mode of life and habitats. Brooks and rivulets, including very small brooks with a moderately strong current.

Distribution. USSR: Carpathians, Caucasus, mountain regions of Middle Asia, southern and East Siberia, Far East. In addition, Europe, North America, Asia.

### Key to Species

Full-grown larva

1 (4). European species.
2 (3). Head and pronotum light, with dark dots; claw of anal legs with small spinules . . . . 6. **Rhyacophila philopotamoides** McL. (p. 297)
3 (2). Head mainly dark brown; pronotum light, without dots; claws of anal legs without spinules . . . 5. **Rhyacophila tristis** Pict. (p. 297)
4 (1). Asian species.
5 (10). Head slightly longer than broad, light, with dark pattern.
6 (9). Forelegs shorter than midlegs and hind legs.
7 (8). Pattern on head brown or light brown, more or less diffuse; dots on head and pronotum large, numerous and distinct . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Rhyacophila sibirica** McL. (p. 275)
8 (7). Pattern on head blackish brown or black; dots on pattern distinct; pronotum light yellow, without dots . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Rhyacophila narvae** Navas (p. 281)
9 (6). Forelegs longer and more massive than mid- and hind legs . . . . . . . . . . . . . . . . . . . . . . . . . . . 4. **Rhyacophila obscura** Mart. (p. 291)
10 (5). Head oblong, narrow, dark, reddish-dark-brown, without pattern; frontoclypeus with indistinct dots; pronotum dark brown, with indistinct spots . . . . . . . . . . . 3. **Rhyacophila lata** Mart. (p. 285)

### 1. **Rhyacophila sibirica** McLachlan

Lepneva, 1949:164–166, Figures 7–10.

**Full-grown larva.** Length 18 mm. Ground color of sclerotized parts yellow or reddish yellow, sometimes brownish; body slender (Figure 1), uniformly broad in the middle, tapering anteriorly and posteriorly. Length of head capsule 1.7 mm, width 1.4 mm; eyes small, situated near anterior margin of head. Frontoclypeus (Figure 274, A) dark anteriorly and at the sides of the middle; sides of anterior part with two large dots; the dark background of the posterior part with a curved row of dots which are large in the middle and small laterally. Of the 3 anterior-margin setae, the seta lateral to the frontal suture is light, curved anteriorly; intermediate seta thin, small; median and anterior frontal seta recumbent; middle frontal seta straight, small; posterior frontal seta thin and long. Dorsal stripes closely adjacent to the frontal sutures, wide posteriorly; the space in the posterior part, lateral to the epicranial suture remains light; stripes with large dark dots; lateral stripes slightly dark and with small dots. The large setae on the head are thin and brown; they are very thin at the end; seta 7 situated on the anterior margin; seta 9 long; posterior to it, nearby, is the small thin seta 11; seta 14, which is almost as long as seta 9, is situated posterior to the eye; lateral to it stands the shorter seta 12; farther posteriorly are the thin yellowish seta 15 and the large brown seta 16 behind each other; lateral to these setae stands the small, thin seta 13; seta 17 is situated near the bifurcation of the suture and is small and light; the small ventral seta 8 is situated at the posterior margin; seta 18 is situated in the anterior part of the head; the large setae 8 are situated at the sides of the gula (Figure 274, B).

Labrum (Figure 275) short and broad; its dorsal sclerite is golden yellow and thin, its membranous border broad; sides of labrum with white hairs; median notch shallow; seta 1 situated on the membrane and light, setae 2 and 5 situated on the margin of the sclerite and long; setae 4 situated on the sclerite at the sides of the median notch; they are short and light; seta 3 situated on the side of the sclerite; it is light and recumbent; seta 6 is situated near seta 3; it is yellowish brown and long.

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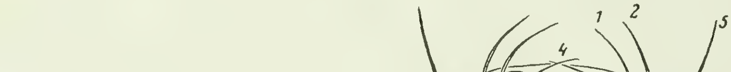


FIGURES 274 and 275. Rhyacophila sibirica McL.:

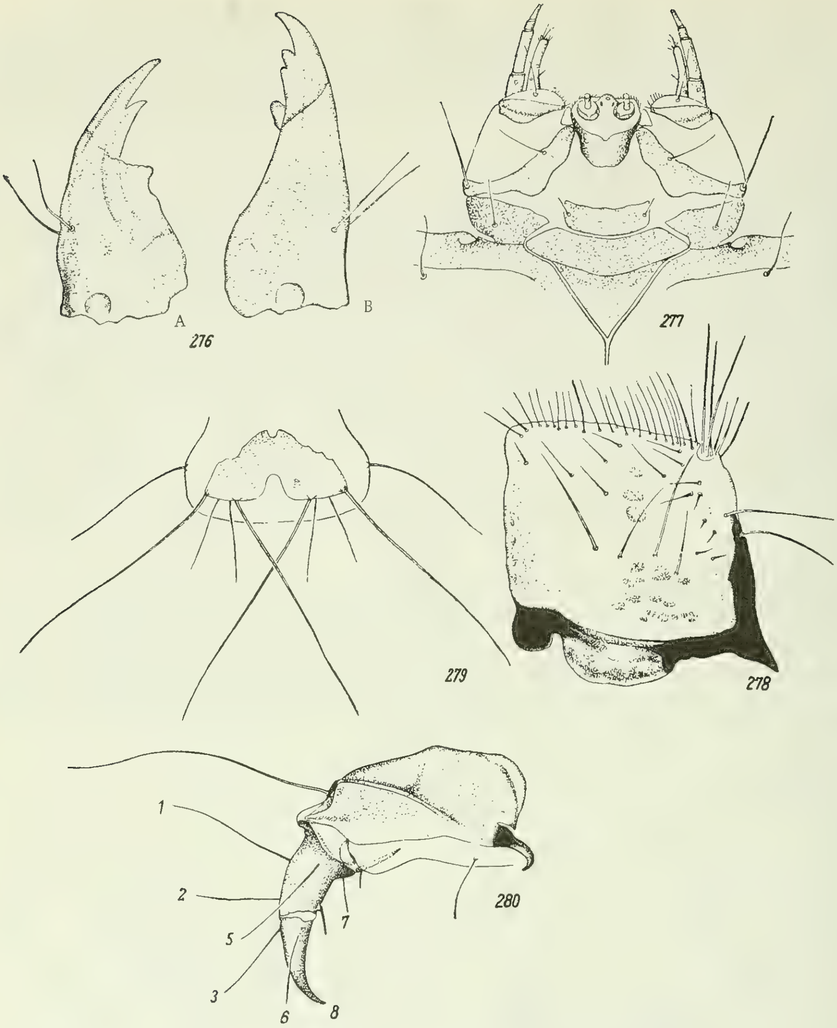
274 — head, dorsal (A) and ventral (B); 275 — labrum, dorsal.

Mandibles are relatively long (Figure 276); upper blade of the left mandible with a large, projecting, distal tooth; lower blade with a finely
259 serrated part with small toothlike processes at the sides; upper blade of right mandible with two distal teeth; lower blade with a large, blunt, basal tooth; the distodorsal outer seta is curved, recumbent, shorter than the straight, basoventral seta.

Submentum forming a broad rectangle (Figure 277) with rounded posterior angles and sharp anterior angles; posterior margin of submentum slightly shorter than anterior margin of pregula; setae small, light, situated near the lateral margin in the middle of the sclerite. Sclerites of the cardo also dark brown; the seta is thin, longer than that on the submentum. The sclerites of the stipes have a yellowish brown outer stripe; they are grayish yellow in the middle in the broad part; basal seta yellowish brown, long, distal seta shorter and thinner. Distal seta of maxillary palpiger situated on a membrane, strong and brown; basal seta small and little marked. Galea and palps relatively narrower and longer than in species of Rhyacophila s. str. The second palp segment is more than twice as long as the first. Mentum dark brown; its anterior margin has a small medial notch; the ventral sclerites form small dots; their setae are thin and light; the sclerites of the sickle-shaped labial palpiger and of the labial palp are brown.

Pronotum (Figure 278) brownish yellow; posterior margin brown in the middle of each half, with a broad, rounded, yellowish process posteriorly; this border is black in the middle and laterally; posterior angles black; lateral margin with a narrow brown stripe in the anterior third and a small brown small spot at the anterior angle; it has a broad black border in the posterior third; it has a brownish red narrow border in the middle. The sclerite bears a row of dots near the median suture; groups of large dots in the posterior part of each half of the sclerite; indistinct dots in curved rows in the middle; The notch at the anterior angle is deep, milk white, with 3 setae which are characteristic for Hyporhyacophila: a long, primary seta and lateral to it, on a small sclerite, 2 secondary setae; the posterior of them is almost as long as the primary seta; the second seta is shorter. Lateral to the notch, at the anterior-angle process is a small, strong, light seta and 2 or 3 small, thin setae. There are dense, small, yellowish, thin setae at the anterior margin and posterior to them are 3 large setae situated at a distance from each other; these 3 setae are as
260 long as the short secondary anterior-angle seta; pronotum with a long brown seta in the middle, near the median row of dots; this seta is as long as the primary anterior-angle seta; a second smaller seta is situated near the curved row of dots; posteriorly, slightly lateral to the above setae is a short light seta; near the lateral margin, at the distal end of the black border, is a large, strong, dark brown seta; a second slightly longer seta is situated anteriorly, at a distance from the border; anterior-angle region with several thin, short, sparse, light setae.

261 Meso- and metathorax large (Figure 1), longer than the following abdominal segments; anterior-margin setae of mesonotum long, brownish; setae of metanotum small and light; anterior-angle setae of both segments long, shining brown; small light secondary setae near them; medioanal setae of the segments brown, strong, longer than the anterior-angle setae; intermediate seta longer and thin; lateral seta small; both setae light.



FIGURES 276–280. Rhyacophila sibirica McL.:

276 — mandibles, dorsal: left mandible (A) and right mandible (B); 277 — gula and maxillolabium; 278 — pronotum; 279 — dorsal sclerite of abdominal segment 9; 280 — right anal legs, outer view.

Propleuron broadly black in the middle of the basal part, brown in the epimeral and episternal regions; episternal sclerite yellowish; the membranous groove separating it is continuous; the integument of the groove is thick; trochantin reddish brown, with dark margins; distal seta strong, dark, relatively large; setules light, one of them slightly larger and thicker; epimeral seta small and situated on a membrane. The longitudinal pleural sclerite of meso- and metanotum is rodlike and very narrow; the seta is dark, relatively long, situated near the distal margin of the plate on a small sclerotized dot; the transverse sclerite is broad, brownish and black in the distal part; epimeral seta small.

Coxa of forelegs short, with a dark basal margin on the dorsal side of the base; the anterodorsal setae are of the same length, strong, dark brown, moderately long; distal seta situated near the margin of the dorsodistal notch; basal seta situated at a distance from the margin; posterodorsal seta smaller than the anterior setae; it is light brown and strong; both anterior setae spinelike and small; the more ventral seta of the two is lighter; distoventral setae small, yellowish and thin; anterior seta smaller than posterior seta. Trochanter sclerotized ventrally; anterior seta short, dark brown and strong; posterior seta lighter, shorter and thinner; of the 5 ventral setae, the subapical posterior seta is yellowish, thin and long; the 3 anterior setae and the basoposterior seta are light, small and spinelike. The femur has a narrow membranous stripe; ventral distodorsal seta thin, long; basodorsal seta shorter and thicker, situated near its middle; anterior seta situated subapically; it is short, dark and strong; posterior seta long, thin and shorter than the dorsal seta; anteroventral seta light, small, spinelike, situated on a membranous stripe, and with a reddish sclerotized dot at the base; posteroventral seta situated further distally on the margin of the sclerite; it is thin and long like the posterior surface seta. Distodorsal seta of tibia thin and long, longer than the distal seta of the femur; second dorsal seta situated further basally, shorter, thin and light; posterior seta situated subapically, brown, long and thin; anterior seta short, spinelike and dark; anterior distoventral seta strong and short; posterior seta slightly larger. Setae of tarsus thin; all 4 setae are situated apically; dorsal setae shorter than those on the tibia; the ventral setae are longer. Basal seta of claw short, blunt, light and strong.

Midlegs and hind legs yellowish brown, lighter and slightly longer than the forelegs. Coxae not sclerotized ventrally; anterior basodorsal seta small and thin; distodorsal seta long and strong; posterodorsal seta thin and small; both anterior setae small and dark; distoventral setae small, yellowish and thin, of almost the same length. Distal part of trochanter not sclerotized ventrally; membranous stripe between the two parts broad ventrally; anterior seta yellowish and long; posterior seta dark brown and short; both posteroventral setae, the long subapical seta and the short light seta situated more basally, all situated on a membrane; 3 anterior setae small and light; distal seta situated on the membranous end of the trochanter; median seta situated on a sclerite; the basal seta spinelike and situated on the transverse membranous stripe. Femur broadly membranous ventrally; dorsal setae brown and thin; distal seta long; basal seta shorter, situated near the middle; anterior seta of midleg yellowish brown, strong, large; posterior seta lighter and only slightly longer; both above setae of the hind leg almost equally long and situated subapically; both ventral setae of the femur situated on a membrane; anterior seta spinelike, light and situated in the middle of the femur; posterior seta situated more distally, near the margin. All 6 setae of the tibia and the 4 distal setae of the tarsus thin; both dorsal setae of the tibia (apical and subapical) almost equally long; posterodorsal seta of the tarsi longer than the anterior seta; distoventral setae of the tibia longer and stronger than the ventral setae of the tarsus. Seta of claw is very small and light.

As usual in Rhyacophila, the first abdominal segment is shorter and narrower than the following segments; segments 3—5 are of about the same

width; the abdomen gradually tapers toward the 8th segment; the 8th segment is much smaller than the others. The anterior-margin setae of segments 1—8 small and setuliform; anterior-angle setae of segments 1—7 situated in the middle of the segments, displaced posteriorly on segment 8, brown and long; medioanal setae similar, broadly separated to the sides of the segment; intermediate and lateral setae situated close together on segments 1—7, small and light; anterior-angle seta long from segment 6 onward and is situated close to the anal setae; all 4 setae of segment 8 (as on segment 9) form a row at the sides of the segment; relatively thick medioanal seta brown and short; thin lateral seta and especially the yellowish intermediate seta longer than on the preceding segments. One of
262 the ventral setae (intermediate seta) long and brown, like the large dorsal setae.

Dorsal sclerite of segment 9 light brown, narrowed anteriorly into a median process (Figure 279); a black anterior margin absent; sclerite slightly dark anteriorly, pale yellow posteriorly, almost white in the middle, with two large grayish dots at the sides; sclerite broader posteriorly than anteriorly; posterior margin with widely separated groups of 4 setae near the posterior angles; medioanal and angle setae long, reddish brown, thick at the base, very thin at the end; intermediate and lateral setae situated between them, short, light and very thin.

The dorsolateral sclerite "b" of the anal legs (Figure 280) is light yellow, with dark brownish scars formed by the oblique groove and the groove perpendicular to it; basoventral hook of the sclerite slightly curved, reddish, with a blackish brown triangular base; the ventral sclerite near the hook forms a small sclerotized dot; the seta on it is thin and light; distally and laterally, a small pointed process at the point of the sword-shaped process of species of Rhyacophila s. str.; distal part of sclerite brownish black in the middle; instead of the distodorsal tubercle, there is a white, weakly sclerotized skin fold; both setae of the part (dorsal and lateral seta) brown, strong and long; the former is longer (not shorter as in Rhyacophila s. str.) than the adjacent short and thin seta of the basodorsal part of the sclerite; such a length of the setae is observed also in larvae of the 1st and 2nd stage of Rhyacophila s. str. Ventral sclerite "c" small; its seta light and thin; lateral sclerite "c" large and yellow.

Claw long; its basal part with a dark margin and a basodorsal blackish brown, beak-shaped process which enters under the fold of the distal sclerite "b" if the claw is flexed. Distal part of claw weakly curved; dorsal and outer setae dark, more or less long; their basal part with the long seta 1 and the shorter seta 2; the distal part bears seta 3 near the transverse, membranous stripe; the long seta 5 is situated laterally near the base; seta 6 is situated in the distal part; the short thin seta 4 is situated near seta 8 in the middle; the light setae 7 and 8 are situated ventrally; seta 7 short and thin; seta 8 reaches the end of the claw, curved and thick.

Mode of life and habitats. Brooks and rivulets with cool water and a rapid current, on stony bottom.

Distribution. USSR: Siberia, Altai, Sayans.

### 2. **Rhyacophila narvae** Navas

Lepneva, 1955:271–277, Figures 1–5.

**Full-grown larva.** Length 12–14 mm. Color of head and thorax mainly whitish yellow or yellow; pattern on head blackish brown (Figure 281); eyes situated on a wide light field. Frontoclypeus dark, lighter and brownish near the curvature of the frontal sutures; both sides of the anterior part with 2–3 indistinct large dots; a curved row of chestnut brown dots in the posterior part. Lateral anterior-margin seta lateral to the frontal suture (Figure 282) light, small and slightly curved inward; intermediate seta straight, short, brownish; median seta larger than the others, like the anterior frontal seta, and recumbent; median frontal seta small; posterior frontal seta long and dark. Dorsal stripes broad; space between them near the coronal suture light; lateral stripes connected with the dorsal brownish stripe near setae 15 and 16; head mainly dark ventrally. Seta 9 long and brown; the short thin seta 11 is situated posterior to it; seta 7 shorter than 9; seta 10 light, small, slightly curved; setae 12 and 14 long, setae 15 and 16 situated in the posterior part of the head, one behind the other; 15 longer than 16. Both ventral setae straight and spinelike; seta 18 slightly longer than seta 8 (as in Rh. sibirica), situated in the anterior part of the head, near the bifurcation of the gular suture.

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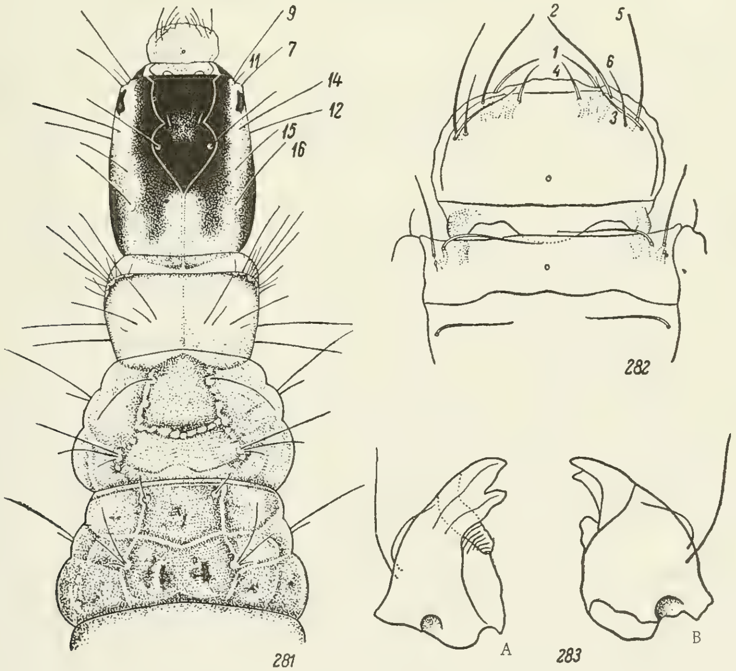

FIGURES 281–283. Rhyacophila narvae Navas:

281 – head and thorax, dorsal; 282 – anterior part of frontoclypeus and labrum; 283 – mandibles, dorsal: left mandible (A) and right mandible (B).

Dorsal sclerite of the labrum (Figure 282) brownish yellow; seta 1 on the membranous margin transparent and curved; margin of sclerite with the short and straight seta 4 in the middle, posteriorly; setae 2 and 5 situated anteriorly on the margin of the sclerite, brownish, relatively large; seta 6 shorter and dark; seta 3 light.

Mandibles (Figure 283) short, blackish brown, massive; left mandible with strongly curved upper blade, with a deep median depression; upper blade with a blunt subapical tooth; lower serrated section with small lateral processes. Upper blade of right mandible distally with a large apical tooth; basal tooth of lower blade blunt and broad. Outer setae situated nearby; one of them straight, the second shorter and curved to the surface.

263 Pregula fused with gula, brownish; submentum lighter, trapezoidal, with a longer anterior margin; posterior angles rounded; seta near the lateral margin in the middle of the sclerite small and light; cardo brownish, with a small seta; stipes broad and yellow; the basal seta of the setae near the margin brown and apical seta shorter and lighter, situated near the middle of the sclerite. Palpiger and galea yellowish and thin; distal seta of palpiger situated on a membrane, longer than the galea; mediobasal seta small and light, situated near the posterior angle of the sclerite; maxillary palps narrow, brownish; 2nd segment is much longer than the others; 3rd segment small, 4th long. Mentum brownish yellow, with a small asymmetrical, median notch on the anterior margin; median suture absent;* the ventral sclerites form small yellowish dots; their setae are light, relatively long, with a very thin end; labial palpiger in form of a wide bracket; palp brownish.

Pronotum (Figure 281) yellowish, without pattern; posterior margin continuous, black, broader in the middle of each half, forming broad processes without light spots or interruptions; the projecting posterior angles and the lateral margins mainly black; anterior third of lateral margin and anterior angle with a narrow brownish border. Light notch near the anterior angle with 3 dark brown, thin setae; primary seta longer than secondary setae; anterior angles with 2 or 3 short setae laterally; a long seta which is almost as long as the angle setae medial to the notch of the anterior angle; small light setae lateral to this long seta. Each half of the sclerite with 2 dark, strong, long setae and 2 small thin setae; posterior dark lateral seta situated near the black margin, anterior seta situated slightly away from the margin of the sclerite.

264 Anterior-angle and medioanal setae of meso- and metanotum and of tergites of the abdominal segments dark and long; anterior-margin seta long also on the mesonotum; it is small on the metanotum and on the abdominal segments; secondary anterior-angle seta small and thin; the thin intermediate seta and the lateral seta stand near the medioanal seta, the former much longer than the lateral seta.

Sclerites of propleuron dark; the region of the pleural suture broad and black; epimeral seta situated on a membrane near the margin of the sclerite; trochantin mainly dark laterally, light brown at the base; distal seta black and setules light. Rodlike pleural sclerites of meso- and metathorax black or blackish brown; episternal seta situated on the sclerite strong, dark and large; epimeral seta situated on a membrane, thin and small.

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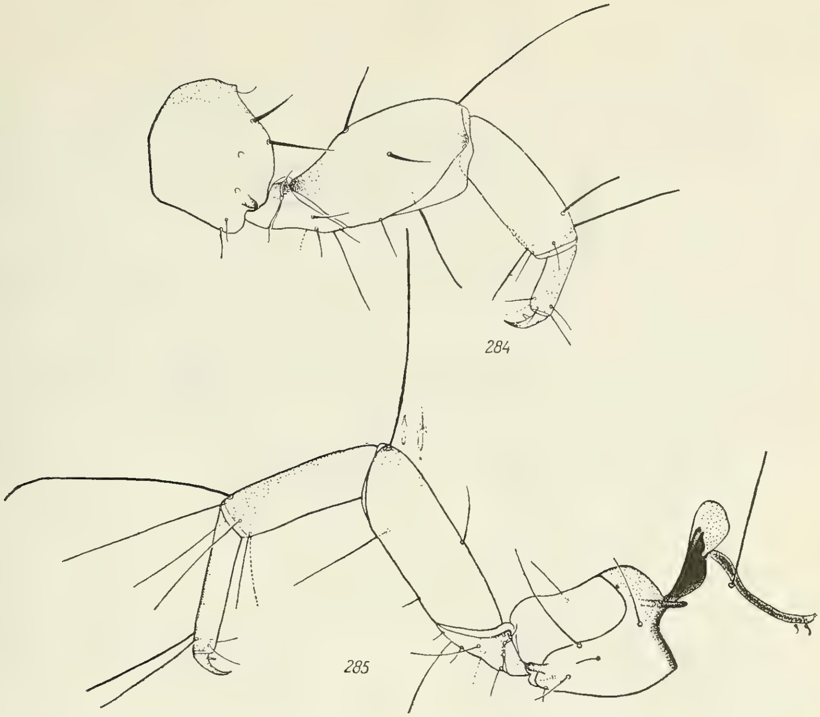
* The continuous surface of the sclerite is clearly visible under high magnification.



FIGURES 284 and 285. Rhyacophila narvae Navas: 284 – left foreleg, anterior; 285 – right hind leg, anterior.

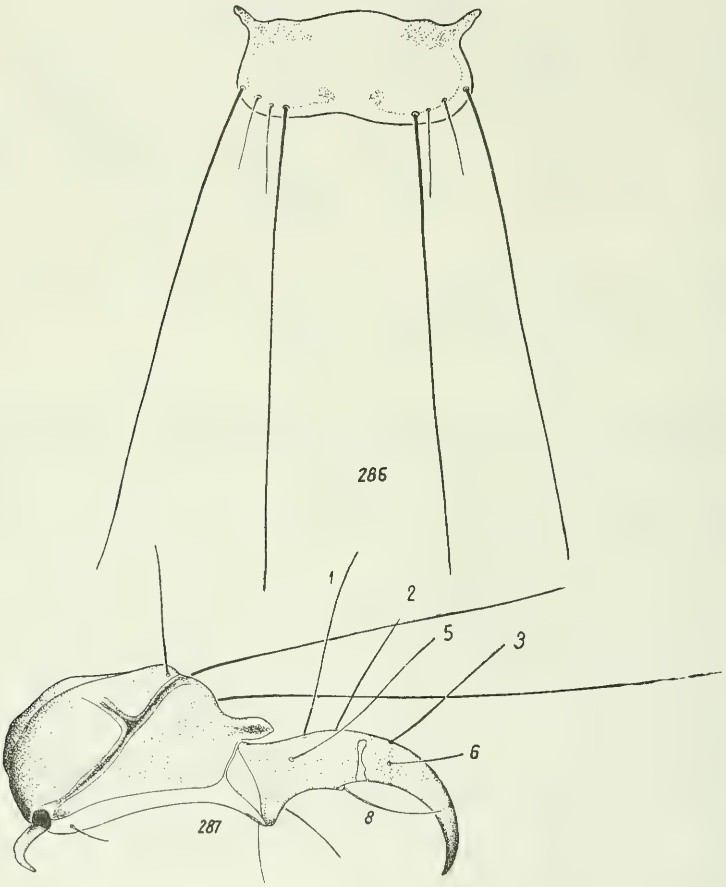
Legs yellowish brown, without dots; forelegs more massive than midlegs and hind legs (Figures 284 and 285). As in Rh. sibirica, the notch on the distodorsal side of the coxae is not as deep as in species of Rhyacophila s. str.; most setae of the legs black or blackish brown; small setae brownish or light. Coxa of the forelegs (Figure 284) with a broad dark basodorsal margin; both anterodorsal setae strong, black and moderately long, basal seta larger; posterodorsal seta longer and thinner; anterior surface setae small and spinelike; anterior seta of the 2 ventral setae, transparent and very small, the seta posterior to it dark and slightly larger, Of the three dorsal setae on the coxa of the hind legs and midlegs, the basal seta is short and thin, the other 2 are dark and long, longer than those of the forelegs; small anterior surface setae straight and thin; both ventral setae small and light.

Trochanter with a less wide membranous area than in species of Rhyacophila s. str.; sclerites of the trochanter not closed at the dorsal end; blackish brown on the forelegs and brown on the midlegs and hind
265 legs; anterior and posterior setae of forelegs short and spinelike, long on the midlegs and hind legs (Figure 285); 3 anteroventral setae small and light; distal seta of this group curved; posterodistal seta dark and long, about as long as the anterior and posterior seta, longer than these two setae on the forelegs; second posterior seta situated ventrally, short and light.

Femora with dark, dorsobasal margin; distal end with two light brown spots lateral to the seta; dorsal setae of forefemur dark brown; those of midfemora and hind femora lighter; basal seta moderately long, situated in the middle of the segment; distal seta, especially on the midlegs and hind legs long, much longer than the basal seta, anterior and posterior seta of the femur of the midlegs and hind legs long; anterior seta shorter than posterior seta; anterior seta on forelegs short, dark and spinelike; posterior seta normal but strong and much shorter than the posterior seta on midlegs and hind legs; ventroanterior seta on forelegs situated at the base, light, spinelike and slightly curved; it is similar but smaller on midlegs and hind
266 legs; posteroventral seta situated subapically at the margin not as long on the forelegs as on midlegs and hind legs, where it is as long as the anterior and posterior setae.

Setae of tibiae of all legs thin, long, dark brown; ventral setae shorter; distodorsal setae on the forelegs not as long as on midlegs and hind legs.

(265)



FIGURES 286 and 287. Rhyacophila narvae Navas: 286 — dorsal sclerite of abdominal segment 9; 287 — left anal leg, outer view.

All 4 setae of tarsus of midlegs and hind legs thin, arranged strictly symmetrically; dorsal setae longer than ventral setae; both pairs of setae on forelegs shorter than on the other legs; difference in length small.

Claws short and strong, their basal seta small, blunt and light.

Dorsal sclerite of abdominal segment 9 (Figure 286) with small, dark anterior-angle processes and rounded posterior processes; anterior-angle and medioanal setae black and long, the latter widely separated; between them, in the middle of the posterior margin, two large brownish dots which are also present in Rh. sibirica; intermediate and lateral setae short and thin.

Anal legs (Figure 287) long as in all species of Hyporhyacophila. Dorsolateral sclerite "b" brown, black at the base; trough-shaped grooves dark; the sword-shaped process of Rhyacophila s. str. is replaced by a small process; basoventral hook of the sclerite reddish brown, with a black base, the sclerite near it small and yellow; seta on this sclerite straight and light; lateral seta of the distal part of the dorsolateral sclerite black and long, much longer than the claw; the seta of the distal part of the sclerite long and black, similar to the lateral seta as in Rh. sibirica; posterior seta near the seta of the basal part dark but much shorter. Unlike in 5th-stage larvae of Rhyacophila s. str., such a ratio is also present in the 1st-stage larvae of this group. Ventral sclerite of sclerite "c" brownish and small, the seta on it yellow, similar to the ventral seta; lateral sclerite "c" thin and yellow, irregularly rhomboidal.

As in all species of Hyporhyacophila, the claws (Figure 287) are long, their basal part almost straight, with a black, upward-directed, dorsal process at the base; distal part uniformly curved; arrangement of the setae as in Rh. sibirica; dorsal seta 1 longer than seta 2; seta 3 situated dorsally, in the distal part; the basal seta 5 longer than distal seta 6; mediobasal seta 4 situated near the suture, thin and short; ventral setae 7 and 8 transparent and curved; seta 7 only slightly shorter than seta 8.

Mode of life and habitats. Brooks and rivulets with cool water, on stony bottom with a rapid or moderately rapid current; on the lower surface of stones.

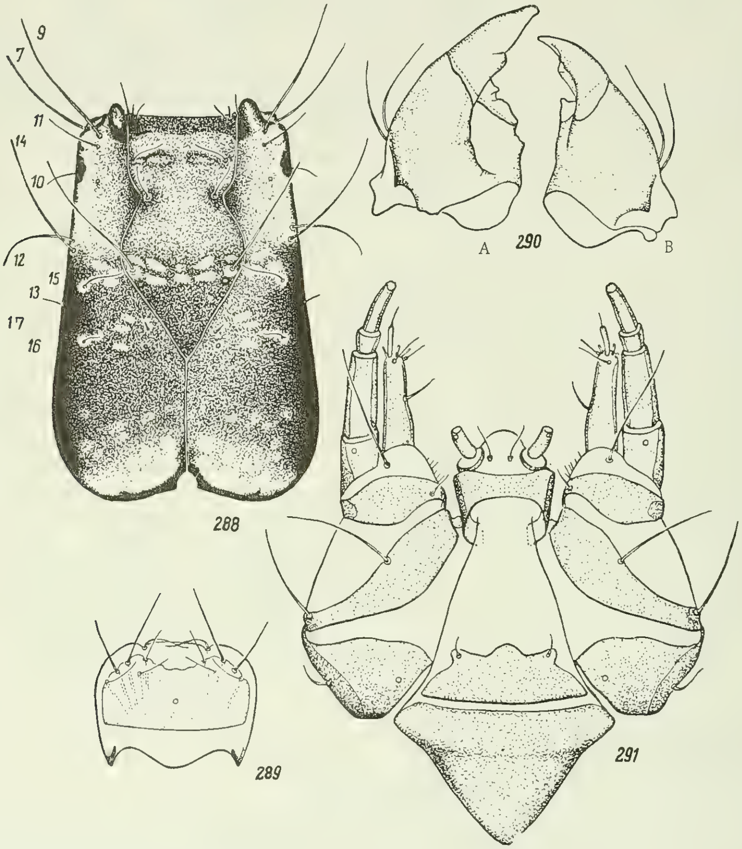
Distribution. USSR: Amur Region and Maritime Territory.

### 3. **Rhyacophila lata** Martynov

Levanidova, 1962:193—194, Figures 4—5.

**Full-grown larva.** Length 12—14 mm. Sclerotized areas chestnut brown; the large setae of the same color and very thin at the end. Head oblong (Figure 288), narrow, dark, 1.2 mm long and 0.75 mm broad; eyes small, situated on a whitish yellow area; area near the occipital foramen light brown. Frontoclypeus with an oblong posterior part; anterior part narrower than posterior part, with two large pale dots laterally; posterior part with a transverse row of similar dots. Lateral anterior-margin and intermediate setae transparent, small, the former slightly thicker, situated lateral to the frontal suture; median seta large and yellowish. Anterior frontal seta recumbent; middle seta small, straight and strong, situated near the curvature of the frontal sutures; posterior frontal setae chestnut brown, long. Seta 9 situated anterior to the eye, as long as the posterior frontal seta; seta 11 transparent, thin, situated posterior to seta 9; seta 7 situated at the anterior margin, long but shorter and slightly lighter than seta 9; setae 12 and 14 situated nearby, posterior to the light field around the eyes; seta 14 much longer than seta 12; seta 15 short but thicker than seta 12; small seta 16 situated in the posterior part of the head; ventral seta 8 situated near the anterior margin of the head, spinelike and transparent; small seta 18 situated posterior to the gula.

(267)



FIGURES 288–291. Rhyacophila lata Mart.:

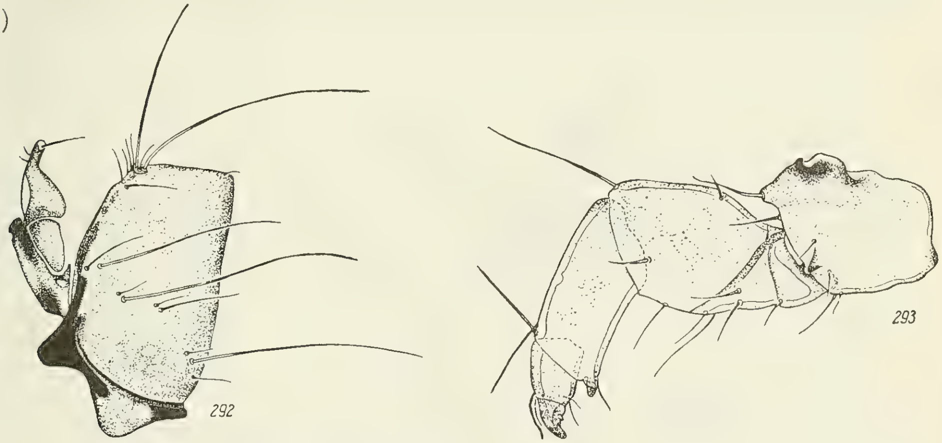
288 — head, dorsal; 289 — labrum; 290 — mandibles, dorsal: left mandible (A), right mandible (B); 291 — gula and maxillolabium.

Labrum (Figure 289) of the same form as in Rh. sibirica, but slightly narrower; dorsal sclerite golden brown, with indistinct margin; membranous border broad anteriorly and laterally; lateral white stripes short. All setae light.

Upper blade of left mandible (Figure 290) with a small tooth in the distal part; the bluntly serrate part of the lower blade with toothlike tubercles at the base and at the end; distal end of upper blade of right mandible with a small rounded tubercle; base of distal part of lower blade of right mandible with one tooth; both outer setae of the mandibles transparent,
267 curved and situated close together; distodorsal seta longer and recumbent.

Submentum large (Figure 291), its posterior margin broad, almost as broad as the anterior margin of the pregula; anterior margin with rounded anterior angles and a slightly asymmetrical, small apically rounded process near the middle; seta small, situated near the anterior angle. Cardo dark brown, the seta situated laterally, short and thin. Stipes yellowish, the setae thin and light; basal seta longer than the others; distal seta situated on a sclerite near the middle of the stipes. Seta of maxillary palpiger situated on a membrane, light, very thin and almost reaching apex of galea; second seta situated basally in the middle; it is small, strong and situated on a sclerite; Mentum broad and short. Palps and distal part of labium as in other species of Hyporhyacophila.

(268)



FIGURES 292 and 293. Rhyacophila lata Mart.:

292 – dorsal sclerite and pleuron of prothorax, lateral; 293 – right foreleg, anterior.

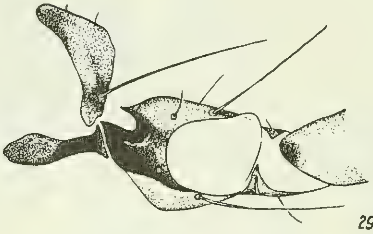
Pronotum (Figure 292) slightly oblong, chestnut brown; its posterior part with a longitudinal row of large, indistinct lighter dots in the middle; groups of similar dots in each half of the sclerite. Posterior margin of sclerite black in the middle and laterally, unusually broad in the middle of each half, brownish, with a large rounded, light posterior process;
268 posterior angles and posterior part of the lateral margin black; lateral margin of the anterior part with narrow brown border. Light notch near anterior angle between the anterior and lateral margins very small, containing the primary anterior-angle seta and one of the secondary setae; both setae long and dark brown; 2nd secondary seta short and light, slightly curved; angle with 3 small light setae laterally; lateral margin

posteriorly with 2 small yellowish setae. Posterior half of sclerite with 2 long brown setae and a seta of moderate length between them; a small, light seta at the base of each of these three setae; 2 setae near the lateral margin; posterior seta shorter.

The strong anterior-angle and medioanal setae of meso- and metanotum long and reddish brown; secondary anterior-angle seta small; intermediate and lateral anal setae situated near the medioanal seta and little marked; anterior-margin seta of the mesonotum large, slightly shorter than the angle setae, dark and almost as long as the pronotum; anterior-margin seta of metanotum very small.

Pleuron of prothorax large (Figure 292); region of pleural suture blackish brown; sclerite of epimeral region clearly marked, brown; seta on the membrane near the sclerite small and light; episternal region brown; groove on the sclerite deep in Rhyacophila s. str., it is complete and well marked in Rh. lata; trochantin with a large dark brown horn-shaped process with a strong, reddish brown terminal seta; trochantin laterally and subapically with 2 thin light setules on a membrane. Pleurites of meso- and metathorax brown, in some places black, relatively broad; seta of episternum dark brown, long and strong; epimeral seta small and thin, situated on a membrane.

(269)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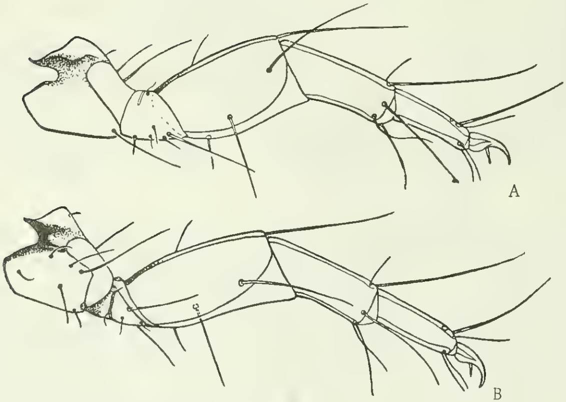


295

FIGURES 294 and 295. Rhyacophila lata Mart.:

294 – mesopleuron, coxa, trochanter and base of femur of the right midleg, dorsal; 295 – midleg: right leg, posterior (A), left leg anterior (B).

Forelegs (Figure 293) more massive, darker and slightly shorter than midlegs and hind legs, dark brown; coxa short; distodorsal notch shallow; anterodorsal margin dark and reddish brown, raised in a crest, with a distal tubercle; a thick spinelike basodorsal seta, displaced from its normal position at the apex of the process; near this seta slightly more ventrally near the base of the tubercle, a short distodorsal anterior seta; posterodorsal seta relatively long, thin and yellowish; both anterior surface setae small and dark; the posterior ventrodistal long, anterior seta short, both yellowish and thin. Trochanter large, prolonged ventrally; posterior seta thin and short, situated near dorsal margin; anterior seta dark, curved, slightly longer than the posterior seta; the middle medioventral seta dark and short; basal seta small, light and situated on the suture; distal seta situated at the end of the trochanter, thin, light and long; both posteroventral setae light; one situated subapically, the second small seta in the middle. Femur thick and short; its ventral margin short; distodorsal seta 269 long and light brown; basal seta short and strong; posterior seta long and thin, situated subapically; anterior seta small and spinelike, dark; unlike in most species of Rhyacophila, both ventral setae are situated distally, close together: posterior seta situated on a sclerite, the anterior seta situated ventrally, on a narrow membranous area, on a small sclerotized dot. Tibia massive, longer ventrally than the femur; one dorsal seta situated distally, brown and long, the other light, short and situated subapically; posterior seta long and thin; anterior seta short, spinelike, reddish brown; posterior distoventral seta in form of a short blunt spine; anterior distoventral seta small and strong. Tarsus much shorter than tibia; both distodorsal setae short, light brown and curved; posterior seta larger than the anterior seta; the distoventral setae are small, spinelike and brown. The basal seta of the claw forms a small, blunt, light spine.

Midlegs brown (Figures 294 and 295), much lighter than forelegs and slightly darker than hind legs. Basodorsal anterior seta of coxa of both pairs of legs short and thin; anterior distodorsal seta situated near the margin of the notch, brown, straight and long; posterodorsal seta also long, longer on the midlegs than on the forelegs, slightly shorter on the hind legs; both anterior surface setae light brown, slightly longer than on the forelegs; distoventral setas short and thin; posterior seta longer than the anterior seta.

Anterior seta of trochanter of midlegs and hind legs thick and chestnut brown, long; posterior seta lighter and shorter; posterior subapical seta of the 5 ventral setae longer; anterodistal seta also moderately long, but not as long as on the forelegs. Femora of both pairs of legs of the usual form, longer than the other segments and not sclerotized ventrally; dorsodistal seta long; basodorsal seta short and strong, situated at a distance from the basal margin; anterior and posterior setae situated subapically, long; posteroventral seta situated on a sclerite, at about 270 midlength of the segment, and long; anterior seta short and situated on a membrane in the basal part of the femur. Tibiae of midlegs and hind legs shorter than femora; posterior distodorsal seta brown and very long, longer than on the femora; anterior seta light and short; posterior and anterior setae resembling the distodorsal seta and long; ventral setae situated subapically; short and strong; posterior seta brown, anterior setae lighter and thinner. Posterior distodorsal seta of tarsus, especially of the hind legs, long, slightly shorter than on the tibiae; anterior seta much shorter and thinner; ventral setae thin and shorter than on the tibiae. Claw and its basal seta thinner than on the forelegs.

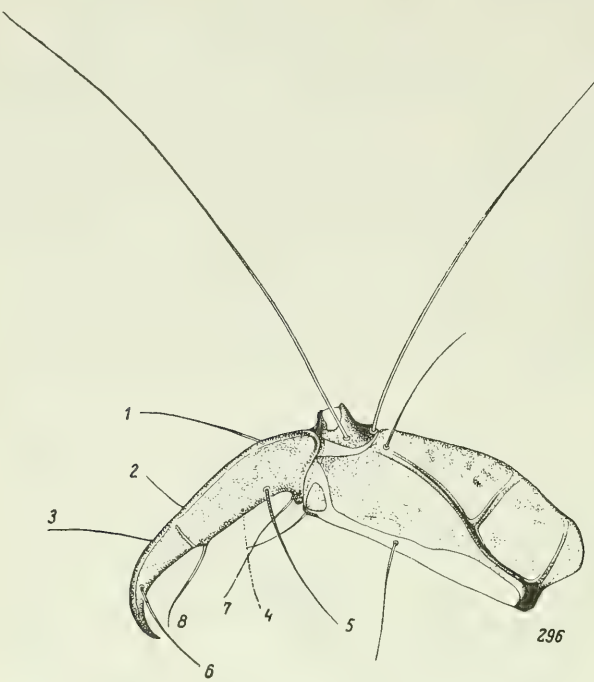


FIGURE 296. Rhyacophila lata Mart. Right anal leg, outer view

Anterior-angle and medioanal setae of abdominal segments 2–8 long, chestnut brown as in other species of Hyporhyacophila, longer than on meso- and metanotum and on abdominal segment 1, and longer than the segment; anterior-angle seta of segments 1–6 situated near the middle of the segment (as in other species of Hyporhyacophila); this seta is displaced toward the anal setae on segments 7 and 8; setae of segment 8 darker, stronger and blackish brown; secondary anterior-angle setae and intermediate and lateral setae thin, little marked; Rh. lata, in this respect, differs from Rh. sibirica because the above setae are well marked; anterior-margin setae of segments small; intermediate ventral seta relatively large, dark; the other 2 ventral setae on segments 2–8 (on segment 1 all 3 ventral setae) are small.

Dorsal sclerite of abdominal segment 9 golden brown, darker in the middle, with indistinct margin; a short, blackish brown stripe in the middle near the anterior margin and lateral to it small anterior-margin setae; 4 setae at the sides of the posterior margin; medioanal setae long, situated close together; anterior-angle setae also long; however, they are shorter than the medioanal setae of the preceding segments; lateral seta long; intermediate seta small and thin.

271 Anal legs (Figure 296) long; dorsolateral sclerite "b" light brown, with dark brown grooves; mediodorsal part of the sclerite with large indistinct dots. Basoventral hook absent and replaced by a blackish brown dark spot, resembling the base of the hook in other species; the small basoventral sclerite with setae also absent; large ventral seta displaced to the middle of the segment; lateral part of sclerite "b" with a dark distal process in place of the sword-shaped process of Rhyacophila s. str. (also in other species of Hyporhyacophila); distodorsal part of sclerite small, the high distal tubercle with a dark apex and 2 very long blackish brown setae which are longer than the claw; seta in the middle of the sclerite situated near the end of an oblique groove (as in Rh. sibirica), shorter and thinner than the setae of the distal part, as in larvae of Rhyacophila s. str.

Claws narrow, with a long, almost straight basal part; dorsal seta 1 of this part strong and dark, longer than the thin and much smaller seta 2; lateral seta 5 situated in the middle of the basal part; it is the longest seta of the claw; median seta 4 situated near seta 8, short and thin; ventral setae 7 and 8 light, large and curved; seta 3 in the distal part of the claw situated dorsally, dark and strong; seta 6 situated more distally and shorter than seta 3.

Mode of life and habitats: Cool brooks and rivulets, on stony bottom.

Distribution. USSR: East Siberia, Khabarovsk Region and Maritime Territory. Not recorded outside the USSR.

### 4. **Rhyacophila obscura** Martynov, larva nova

**Full-grown larva.** Length 11–12 mm (Figure 297). Head dark, chestnut brown, oblong, flattened dorsally, especially anteriorly. Lateral anterior-margin seta light and curved, situated lateral to the frontal suture; intermediate seta in the angle of the sclerite short; unlike in many species of Hyporhyacophila, the median seta is straight and long; anterior frontal seta light and recumbent; the small middle seta situated near the curvature of the frontal sutures; posterior frontal seta dark and long; seta 9 dark and long; seta 7 also large, slightly smaller; seta 11 situated at the base of seta 9, short and thin; seta 10 is small and light, situated lateral to the eye; setae 14 and 12 situated posterior to the eye, almost of the same length; seta 13 small and light; setae 15 and 16 thin and short, situated one behind the other; seta 17 very small; seta 8 short; seta 18 slightly smaller; both setae strong.

Labrum (Figure 298) relatively small; dorsal sclerite light brown, rugose in some places; setae 1 are unusually long for a species of Rhyacophila, light and crossed; seta 2 shorter and straight; setae 4 situated at the sides of the median notch, straight and short; seta 3 light and recumbent; seta 6 long, situated on the surface of the sclerite; seta 5 similarly large, situated near the margin.

Mandibles (Figure 299) short, with large, pointed, distal teeth; they resemble in this respect the larva of Rhyacophila sp. "y" described by Krawany (1935:245); upper blade of the left mandible also with a large subapical tooth; lower blade with the serrated part common in species of Rhyacophila; subapical tooth of upper blade of right mandible smaller than that of left mandible; lower blade with a large blunt basal tooth; outer setae long; distal seta curved.

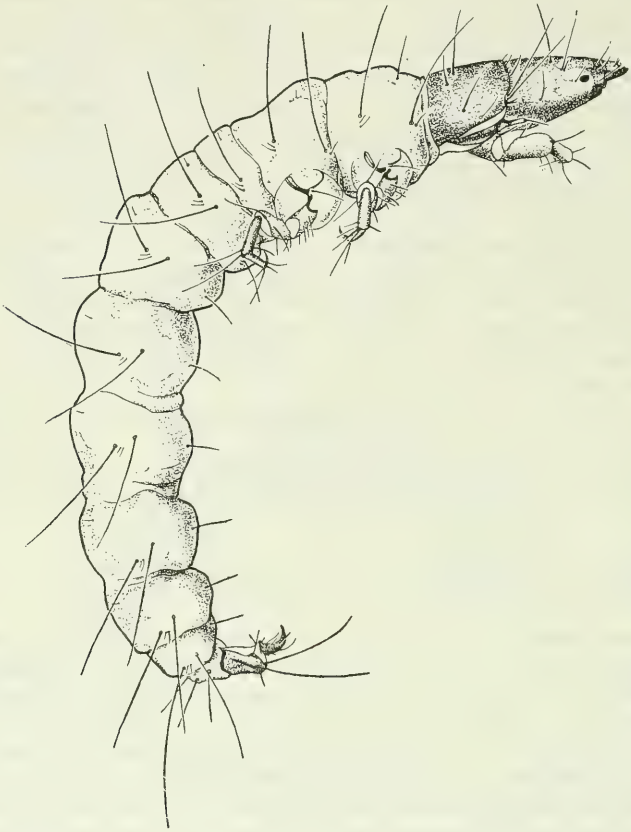
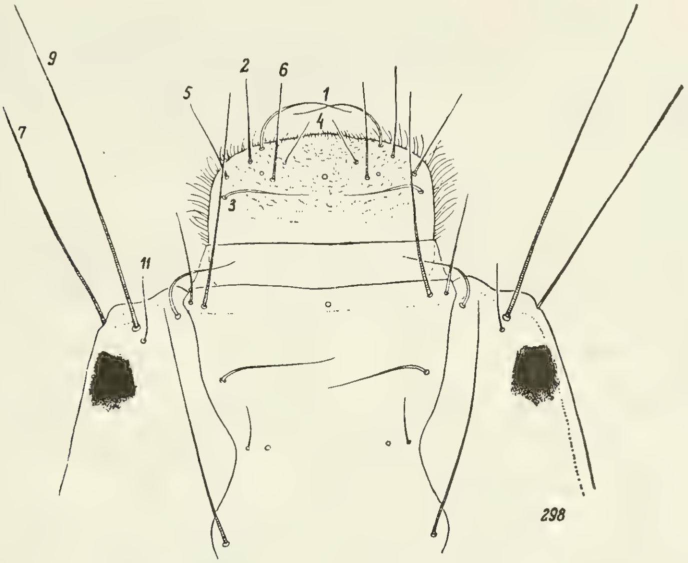


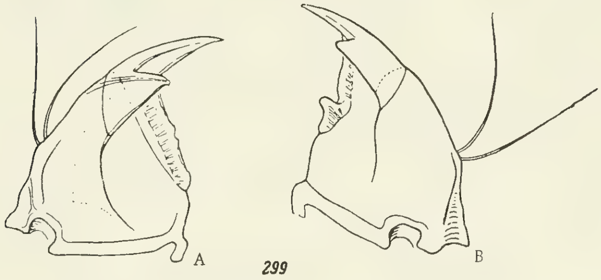
FIGURE 297. Rhyacophila obscura Mart. Full-grown larva, lateral

Maxillolabium shown in Figure 300.

Pronotum brown, shorter in the middle than laterally (Figure 301); anterior margin without a dark border; posterior margin narrow and black, with a broad process in the middle of each half; a second small process near the median suture; posterior angles black, with short processes; lateral margin with a dark border in posterior half, but without border in the anterior part. The primary seta of the anterior-angle depression and one of the secondary setae long and black, longer than the sclerite; the 2nd secondary anterior-angle seta between them is very small, as in Rhyacophila s. str.; anterior angle with 3 small setae laterally; there are small light setae at the anterior margin, 2 or 3 of them are larger; posterior part of sclerite with a long medioanal seta; a pit posterior to this seta; a small seta laterally near the base; 2 short setae in the middle of each half; 2 strong black setae near the lateral margin, one near the margin and the second slightly away from the margin; 2 small thin setae close to the anterior angle.

(273)





FIGURES 298 and 299. Rhyacophila obscura Mart.:

298 – anterior part of head, dorsal and labrum; 299 – mandibles, dorsal: left mandible (A) and right mandible (B).

Mesonotum slightly larger than metanotum. Anterior-margin seta of mesonotum well developed and large, that of the metanotum small but well marked; anterior-angle seta of both segments long, dark, with a small secondary seta at the base; medioanal seta also long, longer than the setae of head and pronotum; a small intermediate seta and a small lateral seta at the sides.

272 Sclerite of pleuron of prothorax large; epimeral region near the pleural suture weakly sclerotized; episternum continuous and light; trochantin large, with a long hornlike process and a strong, long seta; both setules situated at the base of the process (Figure 302).

Pleuron of meso- and metathorax consists of a longitudinal and transverse sclerite; the longitudinal sclerite is broader than the transverse sclerite, which is very narrow; seta of episternum relatively large; small seta of epimeron situated on a membrane.

Legs short. Forelegs (Figures 302—304) more massive and slightly longer than midlegs and hind legs. Coxae short, broad at base; both anterodorsal setae close together, short, strong and situated near the margin of a deep, distodorsal notch; basal seta situated at a marked distance from base of segment; posterodorsal seta long and thin; both anterior surface setae small and strong; distoventral setae thin and small; posterior seta larger than anterior seta.

Trochanter with an oblong distal part; anterior seta short and strong; posterior seta is similar but thin; distal anteroventral seta, forming a small thick spine; middle and basal setae small and strong; basal seta situated near the suture; the subapical posteroventral seta long and dark; the 2nd seta small and thin.

273 Femur short and massive, with short rows of minute spinules which are better marked near the ventral margin. Basodorsal seta situated basal to the middle of the segment, short and thick; distodorsal seta thin and relatively long; thin posterior seta situated subapically; anterior seta situated at a distance from the margin, short and strong; posteroventral seta long and thin; anteroventral seta short and spinelike.

Tibia and tarsus with similar minute spinules but are sparser. Both distodorsal setae of the tibia thin; the posterior seta long and the other short; anterior surface seta divided (Figure 305), small and stronger than the thin posterior seta; both ventral setae thin; posterior seta longer than the small anterior seta. The setae on the tarsi are situated distally; the anterodorsal seta larger and stronger than the posterior seta; the anteroventral seta smaller than the posterior seta.

Claw weakly curved; seta strong and spinelike (Figure 306).

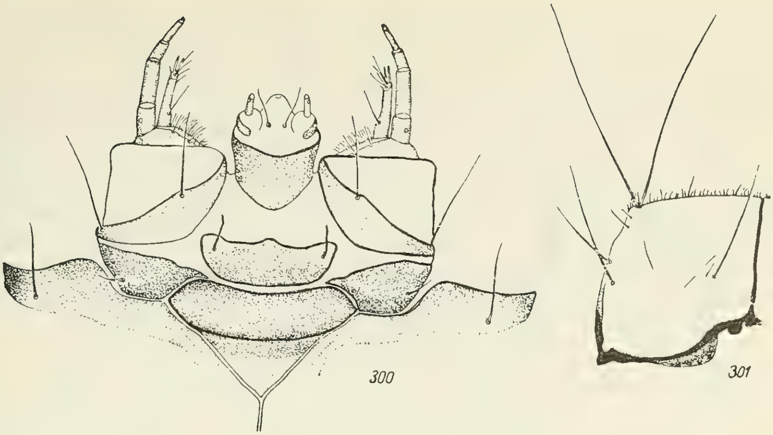
Midlegs thinner than the hind legs, both legs of about the same length.

Abdominal segment 1 much shorter than the following segments; anterior-margin seta of segments 1—8 small and distinct; anterior-angle seta of segments 2—8 long and strong, as on the meso- and metathorax; medioanal seta similar; intermediate and lateral seta small and thin.

275 One of the ventral setae is relatively large. The sclerite of segment 9 forms a thin sclerite (Figure 307); it has a narrow reddish brown border near the anterior margin; posterior margin of sclerite is thinner; median notch of the posterior margin hardly marked; lateral lobes widely separated, pale yellow near the posterior margin, with strong, long median and anterior-angle setae laterally; intermediate and lateral setae situated between them short and thin, light brown and relatively large.

Anal legs of characteristic structure; dorsolateral sclerite "b" (as in Rh. lata and Rhyacophila sp. "y") (Krawany, 1935:246—247) without a basoventral hook; instead of the hook, the ventral side bears a curved, pointed process at the black basal margin; the distal part of the sclerite

(274)



FIGURES 300 and 301. Rhyacophila obscura Mart.:

300 – anterior margin of head, ventral, gula, pregula and maxillolabium; 301 – pronotum.

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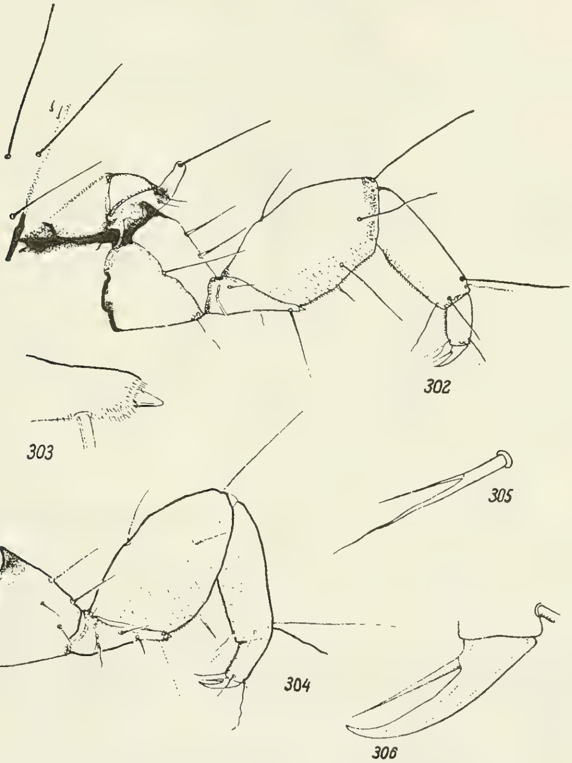
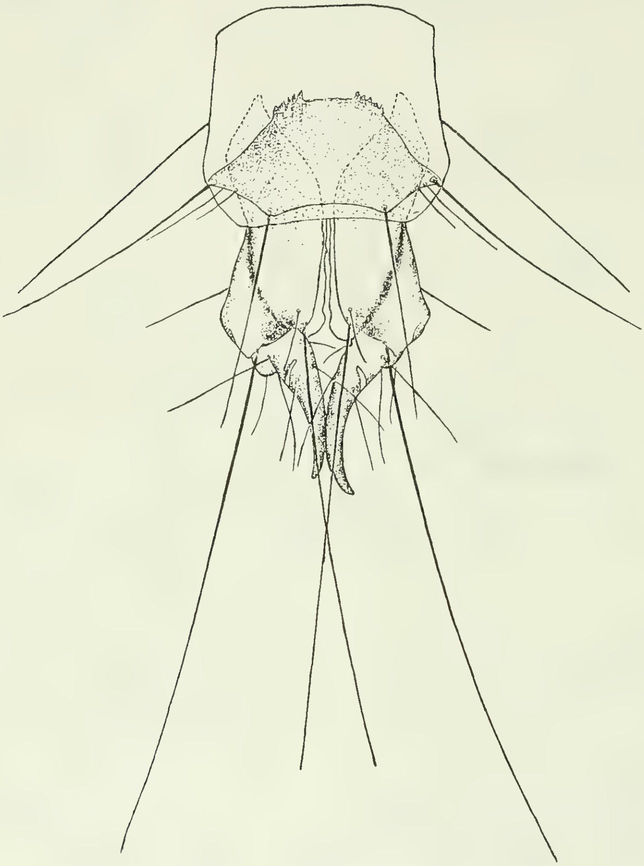


FIGURES 302–306. Rhyacophila obscura Mart.:

302 – margin of pronotum, propleuron and posterior view of right foreleg; 303 – distal end of trochanter (posterior view); 304 – anterior view of left foreleg; 305 – seta of tibia; 306 – claw of foreleg.

(unlike in many other species, e. g., in Rh. narvae and apparently also in Rhyacophila sp. "y") forms a trapezoidal, posteriorly tapering sclerite which is thickened at the margin; it is directed downward toward the claw, resembling the articulation of sclerite "b" and the claw in Philopotamidae; there is a curved notch at the end of the distal part of "b"; distodorsal tubercle absent; 2 setae laterally, near the dorsal margin of the sclerite; they are dark, very long, directed posteriorly and situated at the sides of the
276 claw; distal seta in the middle short and strong. Basoventral plate of section "b" absent; ventral seta displaced to the ventrodistal part of section "b." Sclerite "c" consists of a ventral plate; a lateral plate absent; seta short and thin.

(275)



FIGURES 307. Rhyacophila obscura Mart. Dorsal sclerite of abdominal segment 9 and anal legs

Basal part of claw (Figure 308) shorter than distal part; as in several species of the group Hyporhyacophila (sibirica, narvae and others), it is without ventral spinules. Seta 1 and seta 2 small, setae 3, 5 and 4 very long, situated on the outer and inner side of the basal part;

seta 6 situated laterally in the distal part and shorter than seta 5; basoventral seta 7 very short, small and thin; seta 8 normal, thick and light.

Mode of life and habitats. Mountain and high-mountain brooks and rivulets; common in mountain streams in Middle Asia.

Distribution. USSR: mountains of Middle Asia. In addition, Iran, Pakistan.

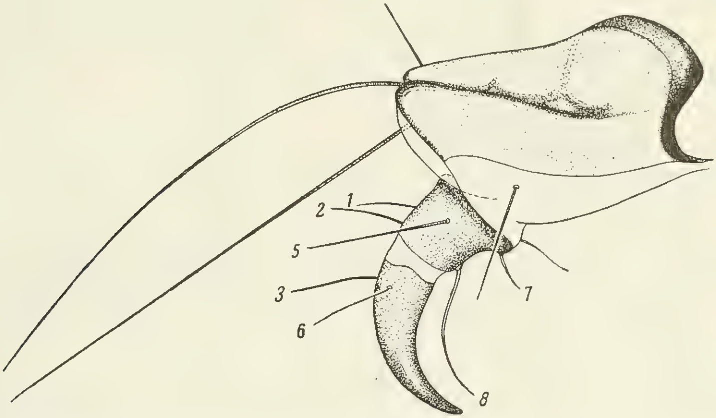


FIGURE 308. Rhyacophila obscura Mart. Right anal leg, outer view

### 5. **Rhyacophila tristis** Pictet

Pictet, 1834; Plate XV, Figure 2. — Hagen, 1864:143. — Ulmer, 1902c:492; 1903:128; 1903c:349. — Thienemann, 1905a:286. — Ulmer, 1909:220, Figure 34. — Lestage, 1921:417, 419.

**Full-grown larva.** Length 9—10 mm. Pattern on head blackish brown. Pronotum yellowish; dots indistinct. Claw of anal legs without spinules.

Mode of life and habitats. Small brooks.

Distribution. USSR: southwestern boundary areas of the USSR. In addition, Europe.

### 6. **Rhyacophila philopotamoides** McLachlan

Thienemann, 1905:285—287, Figures 1, 3, 5. — Ulmer, 1909:320, Figure 345, a. — Lestage, 1921:415—419. — Döhler, 1950:275.

**Full-grown larva.** Length 9—10 mm. Head light, yellowish brown, with a distinct, rich, punctate pattern (Figure 309); stripes and spots on head absent; the pattern consists of a transverse row of dots in the posterior part of the frontoclypeus and several longitudinal rows of large and small dots in the place of the dorsal and lateral stripes; ventral surface of head light.

Pronotum also yellowish brown, with dark brown dots in a longitudinal row near the posterior half of the median suture and two large lateral groups. Claw of the holding apparatus bears two small spinules ventrally.

277 **Pupa.** Mandibles almost symmetrical; right and left mandible each with two teeth, situated in about the middle of the mandible; distal tooth and distal part of mandible serrated.

Mode of life and habitats. Mountain brooks, under stones.

Distribution. USSR: near the southwestern boundary. In addition, Europe.

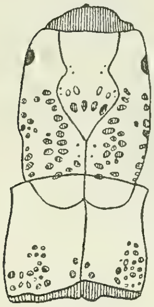


FIGURE 309. Rhyacophila philopotamoides McL. Head and prothorax (after Thienemann)

## 2. Genus **Himalopsyche** Banks

**Full-grown larva.** Large, 30–32 mm long. Head, thorax and abdomen dorsoventrally flattened; thorax broader than abdomen; body of full-grown larva tapering posteriorly from the metathorax, like the body of the young larva.

Head short; head slightly broader than long; frontoclypeus broad; curvature of frontal sutures sharply marked; lateral anterior-margin seta situated inside and not laterally to the frontal suture. Gular suture not longer than coronal suture. Dorsal setae of head short and partly spinelike. Mandibles massive, with projecting basal tubercles on the outside; serration present on both mandibles. Submentum with almost straight anterior and posterior margin; setae are situated in about the middle of the sclerite; 2nd segment of the maxillary palps shorter than 1st segment. Pronotum broad, with a longitudinal row of secondary setae on both sides of the median suture; primary anterior-angle seta short. Meso- and metathorax with conical tracheal gills. Forelegs more massive and longer than the midlegs and hind legs.

Tracheal gills on the sides of abdominal segments 1–8 with a conical, long stalk and numerous gill filaments on the dorsal side. Setae of abdominal segments and of meso- and metathorax small, thin and dark.

Anal legs short; dorsal seta of the basal part of sclerite "b" shorter than both setae of the distal part. Claw with characteristic flattened seta 2.

Mode of life and habitats: Mountain brooks and rivulets, including large high-mountain streams fed by snow.

Distribution. USSR: mountains of Middle Asia. In addition, Central and southern Asia, Japan.

Key to species

Full-grown larva

1 (2). Larvae 30–32 mm long; head slightly broader than long; legs with a distinct pattern of stripes and dots; the forked process of sclerite "c" of the anal legs absent . . . . **1. H. gigantea** Mart. (p. 299)

2 (1). Larvae 22—23 mm long; head narrower than long; punctate pattern on legs indistinct; stripes absent; outer plate of sclerite "c" with massive, laterally projecting process which is curved at the end and bifid like a fork . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Himalopsyche** sp. "larva hoplura" Lepn. (p. 307)

1. **Himalopsyche gigantea** Martynov (Rhyacophila gigantea Martynov)

Brodskii, 1935:75—76. — Lepneva, 1945:62—73, Figures 1—11; 1958a:37—42; 1960:105—107.

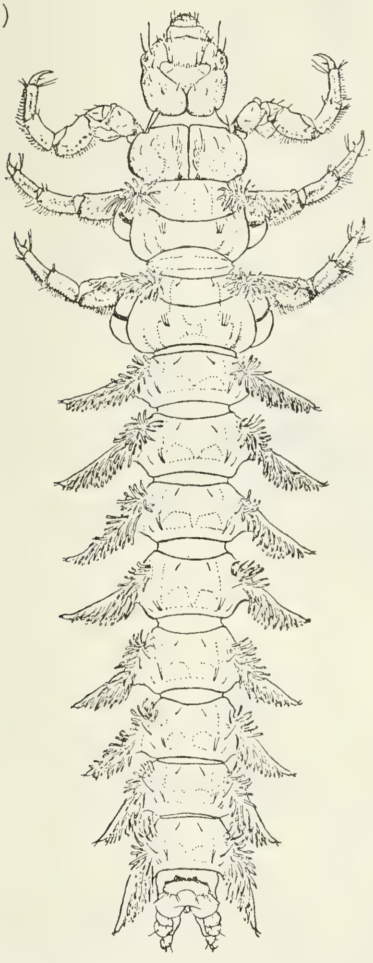


FIGURE 310. Himalopsyche gigantea Mart. Full-grown larva, dorsal

(278) **Full-grown larva.** (Figure 310). Body of characteristic form, long, flattened, slightly tapering posteriorly; length 30—32 mm; sclerotized areas yellowish brown, with a distinct punctate pattern; coloration of membranous parts of live specimens green, with a white network of respiratory stripes and spots; gill filaments whitish.

Head broad (Figure 311), dorsoventrally flattened; length 2.1 mm, width 2 mm. Frontoclypeus with distinct brown anterior 278 margin; anterior part of sclerite yellowish, with two pairs of indistinct dots at the sides; posterior part brown,* with large dark spots; similar dots on the dark dorsal stripes and at the sides of the head; several indistinct dots on the ventral side. Anterior-margin setae small; all 3 setae situated in a row in the angle of the sclerite; lateral seta light; intermediate and median setae brown; median setae thicker than the others; frontal setae also small and thick; anterior seta light, shorter and lighter than the others; middle seta situated on the dark tentorial pit; posterior seta situated near the frontal suture. Seta 9 long and strong, reddish dark brown at the base; seta 11 situated nearby, very thin and small; seta 7 is similar to seta 9 but shorter and thinner; seta 10 transparent and small, situated lateral to the eye; the strong dark setae 14 and 12 are situated posterior to the eye but near it; seta 12 slightly shorter and thicker; setae 15 and 16 like the above setae, situated one behind the other lateral to the dorsal stripes; seta 16 darker and thicker; setae 13 and 17 small and light; seta 17 situated near the frontal suture, anterior to the bifurcation; a pit posterior to it.

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* The color of the sclerites and setae is given from alcohol specimens; when examined in preparations, the sclerites are not reddish brown but yellow; setae and borders are also lighter than in whole larvae.

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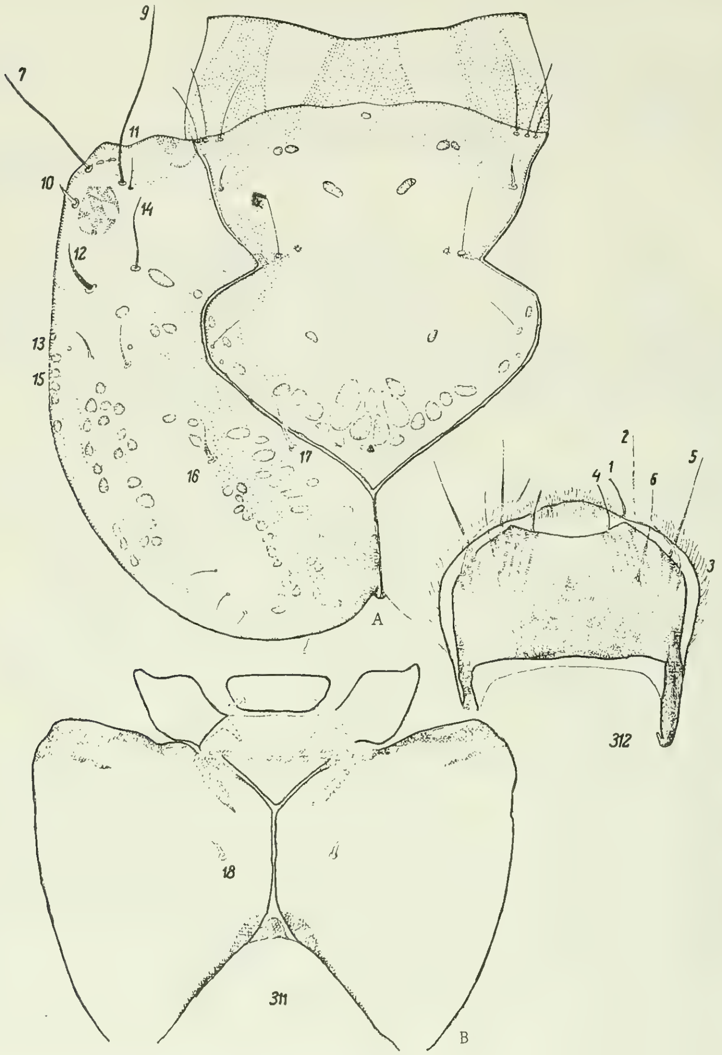

FIGURES 311 and 312. Himalopsyche gigantea Mart.: 311 – head, dorsal (A) and ventral (B); 312 – labrum.

Anteclypeus flexible, light, with 3 broad, brownish longitudinal stripes. Labrum (Figure 312) rounded anteriorly and laterally, broadly membranous, with dense short light hairs; dorsal sclerite yellow, brownish posteriorly in the middle with large dots; median notch of anterior margin deep; posterior-angle sclerites straight, with blackish brown base and a steeply curved end. Seta 1 light, situated on a membrane among small hairs; setae 4 also small and yellowish, situated lateral to the median notch; setae 2 and 5 dark brown, large, larger than the others; seta 6 similar, but smaller than setae 2 and 5; seta 3 situated posterior to seta 5, light and curved inward.

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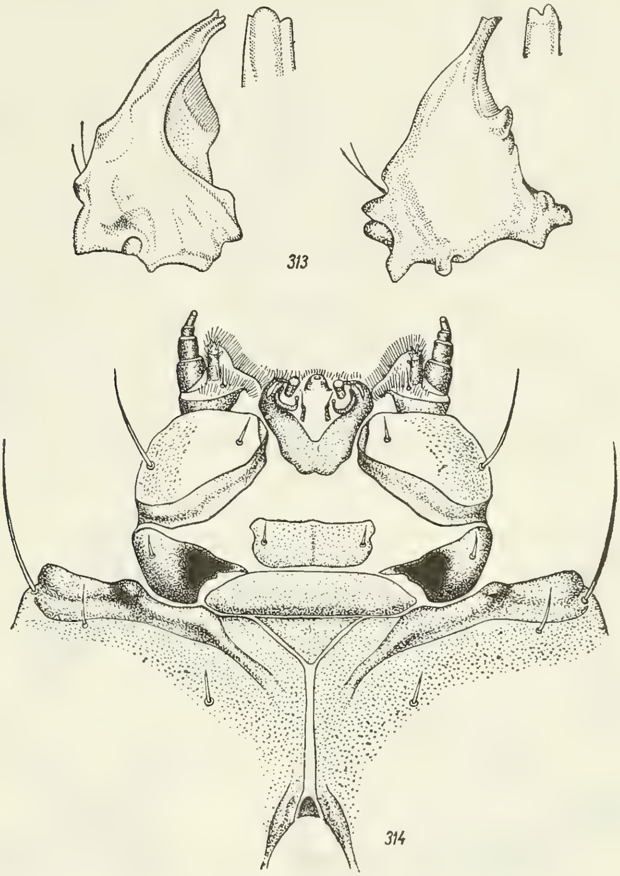

FIGURES 313 and 314. Himalopsyche gigantea Mart.:

313 — left mandible, dorsal and right mandible, ventral; 314 — part of head, ventral, gula, pregula, postgula and maxillolabium.

Mandibles (Figure 313) chestnut brownish, massive and relatively short, with a broad outer surface and a lighter, narrow apex. Distal tooth of left mandible broad, slightly pointed or blunt (before molting); short upper blade with a pointed terminal tooth; lower blade with a similar tooth and a broad, projecting, serrated part; the apex of the mandible thus bears 3 denticles; characteristic large tubercles present near the base of the

mandible, above the basal process of the outer margin, and above the acetabular pit; outer tubercle with a straight or slightly curved, relatively short brown basoventral seta near the base on the distal side; distodorsal seta situated nearby, in a saddle-shaped notch anterior to the tubercle; it is curved and light. Apex of right mandible with two teeth separated by a notch, one on the little marked upper blade and one on the lower blade; the latter has a serrated part; basal margin of this part with a large conical process; the tubercles at the base resemble those on the left mandible;
279 median tubercle slightly smaller than that on the left mandible; outer tubercle is larger; setae similar.

Maxillolabium (Figure 314) reddish brown. Pregula fused with the gula, broad and short. Posterior margin of submentum straight; posterior angles rounded; anterior margin slightly concave, with projecting anterior angles; setae small, situated near the lateral margin of the posterior part of the sclerite. Cardo with a broad blackish brown area in the middle; seta short and yellowish; stipes with a sharp, dark, longitudinal rib; both setae situated on a membrane; basal seta strong and dark. Palpiger
280 shorter than the 1st palp segment; distal seta on the membrane large and light; mediobasal seta small and situated on a sclerite; maxillary palp dark brown; the 1st segment (not the 2nd) is the longest; the 3rd segment is the shortest; galea short with numerous long, light hairs. Mentum complete, with a deep curved notch at the anterior margin; ventral sclerites rodlike, dark, with a small seta near the anterior margin; labial palp broadly bracket-shaped; labial palps relatively large, brownish.

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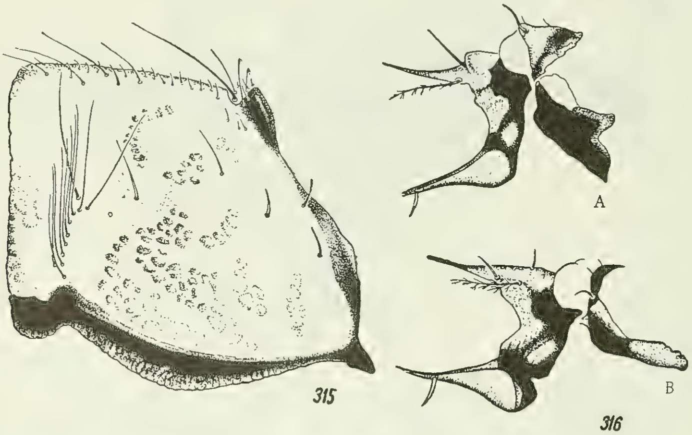


FIGURES 315 and 316. Himalopsyche gigantea Mart.:

315 – pronotum; 316 – propleuron and base of coxa of foreleg (A); mesopleuron and base of coxa of midleg (B).

Pronotum (Figure 315) brownish near the anterior margin; anterior-angle depression shallow, light; anterior angle projecting, with a dark reddish black spot; posterior margin broad, brownish black, with a broad, uniformly rounded reddish process in the middle of each half; lateral margin dark, with a large black spot in the posterior third. Posterior part of sclerite with a characteristic T-shaped figure consisting of a row of dots at the median suture and of several dots anteriorly, lateral to the row; each half of the sclerite with large groups of dots.

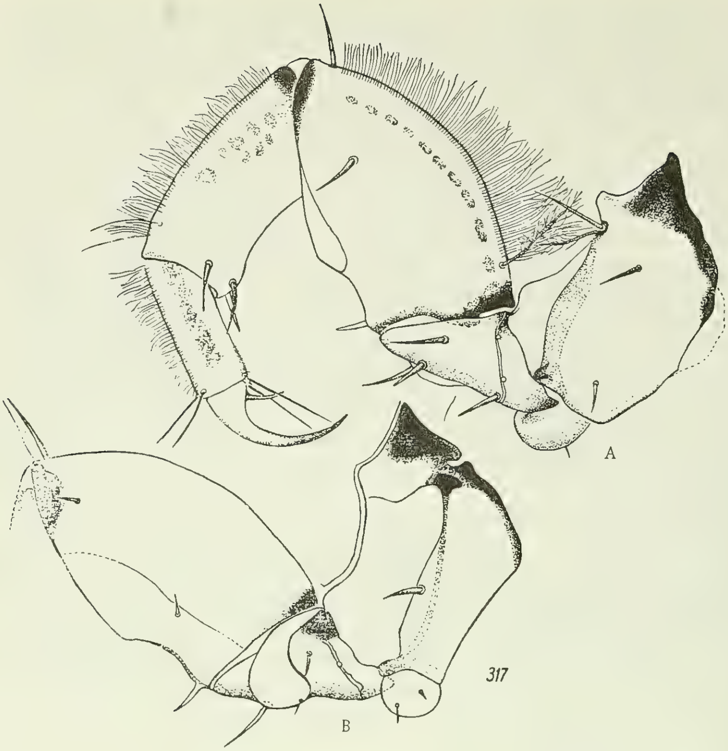
281 Primary anterior-angle seta situated in a light depression, thick, dark brown and large; the 2 secondary setae on the sides are short and light; the black anterior-angle process with 3 thin light setae and several very small setae; small, light setae curved toward the middle at the anterior margin; 3 or 4 short dark brown setae in the middle of the sclerite posterior to these setae, lateral to the suture. Between the medial punctate figure and the lateral groups of dots stands a thick, brown primary medioanal seta; there is one seta nearby and lateral to it; a row of 8 or 9 shorter and thin, dark, secondary setae posteriorly which is characteristic for Himalopsyche. The middle of each half of the sclerite has several short, small setae in the punctate region; some of them are dark and thick; 2 short, strong, chestnut brownish setae situated one behind the other near the lateral margin.

Metathorax slightly larger than mesothorax (Figure 310); in the pleural region, the gills anterior to the base of the legs consist of a conical, long stalk with numerous filaments on the dorsal side and with several filaments on the dorsum of the thorax near the base of the stalk. The setae of meso- and metathorax are strongly reduced in size, thin and reddish brown; there is similarity between the small anterior-margin seta of both segments; the primary anterior-angle seta and the very small secondary seta near it are both situated among the gill filaments, near the base of the stalk; medioanal and intermediate setae of the same length; lateral seta slightly smaller.

The propleuron (Figure 316, A) consists of a thick blackish brown sclerite in the greater part of the episternal-epimeral region; episternum yellowish, indistinct; seta of epimeron small; distal process of trochantin shorter than in Rhyacophila s. str.; trochantin brown, with a broad dark stripe at the base; seta on the membranous apex reddish brown, strong, situated near the margin of the sclerite on a small sclerotized dot; both setules situated on a membrane, one behind the other, and light.

The pleurites of the meso- and metathorax form narrow sclerites, the transverse sclerite larger and yellowish brown in its basal part, with large dots; distal part directed toward the leg with a broad black stripe; seta on epimeron situated on a membrane, small and dark; longitudinal sclerite mainly reddish brown; seta small; both setules of the trochantin (which is fused with the episternum) situated anteriorly near the margin of the sclerite and light (Figure 316, B).

Legs (Figures 317 and 318) short; midlegs and hind legs slightly longer and thinner than forelegs; femur of forelegs more massive than that of midlegs and hind legs; coxa shorter. Legs yellowish brown, with dark pattern and a dorsal longitudinal crest of whitish hairs on femora, tibiae and tarsi. Sclerites and some membranous parts of the legs with numerous minute chetoids; ventral membranous area between coxa and trochanter inflated, with numerous minute spinules. Most setae short, some of them reduced in size.



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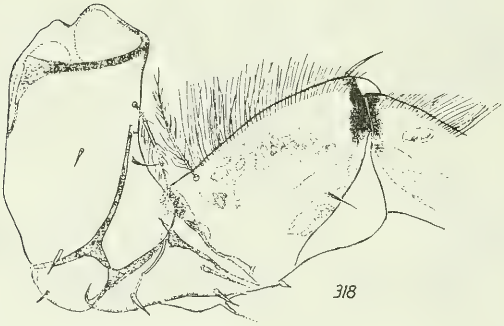

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FIGURES 317 and 318. Himalopsyche gigantea Mart.:

317 – forelegs: right foreleg, anterior (A), and left foreleg, posterior (B); 318 – left midleg, anterior.

282 Distodorsal depression of coxa of all 3 pairs of legs deep; an anterior basodorsal tubercle on coxa of foreleg at the base of which both anterodorsal setae are situated; the basal of these setae moderately long; distal seta feather-shaped, strong and dark brown; posterodorsal seta short, light brown; both anterior setae reddish brown, short and spinelike; both

distoventral setae small, smaller than the setules on the convex part of the membrane; anterior seta clearly marked, projecting; posterior seta small, hardly distinguishable among the spinules.

Trochanter membranous ventrally and posteriorly in a large area of the distal part; anterior seta short, reddish-dark brown and strong; posterior seta small and yellowish; basoventral seta situated on the suture and the median seta forms two thick yellowish spines; distal seta rudimentary, very small and light; posteroventral seta situated subapically, strong and situated on a membrane; second posterior seta situated farther basally, hardly distinguishable among the chetoids of the membrane.

Femur strongly convex dorsally, with a crest of thin and light hairlike chetoids (spines) which become shorter toward the distal end; a row of large dots anteriorly, near the base of the crest; basodorsal seta situated near the base of the crest, straight, dark, moderately long and feather-shaped; distodorsal seta short and thick, light brown; anterior seta situated subapically; short, thick and dark brown; posterior seta lighter and smaller; anteroventral seta situated basally, short, spinelike, yellowish and thick; posteroventral seta situated in the middle of the segment near the margin of the sclerite, small, thick and yellowish brown.

Tibia also massive, with a broad dark stripe and 3 large dots anteriorly; hairs of dorsal crest shorter near the base than near the apex. Setae short and strong; distodorsal setae situated close together, brown, longer and thinner than the others; posterior surface seta smaller than anterior seta; both distoventral setae thick; spinelike setae reddish brown; anterior seta curved; posterior seta straight.

Tarsus with a dark stripe anteriorly; hairs of the crest smaller than on the tibia and shorter toward the distal end; distoventral setae long and strong, relatively thin; dorsodistal setae shorter and thicker; there are minute light spinules ventrally at the margin.

Claw large, curved, with a large basal seta.

There is no basal tubercle on the coxae of forelegs and hind legs; anterior basodorsal seta feather-shaped as on the forelegs and slightly longer; distodorsal seta situated at a distance from the basal seta, small and dark; posterodorsal seta short, thick and brown; it is slightly shorter on the hind legs; unlike on the forelegs, the basal of the 2 anterior surface setae is smaller than the apical seta. Trochanter and its setae on the forelegs. Femur less massive; dorsal setae similar; anterior surface seta thinner, brown, situated slightly more distally than on the forelegs; posterior seta and the posteroventral seta longer, lighter and thinner on the hind legs; basoventral seta similar. Coloration and form of tibia and tarsus as on the forelegs; distoventral setae of tibia and tarsus slightly longer. Claws slightly longer than on the forelegs; seta similar.

Abdominal segment 1 shorter than 2; segments 2—5 are about equally broad; width of abdomen decreasing posteriorly. Gills with long conical stalk, the dorsal surface covered with numerous gill filaments, except on the thin light tip. Gills of segments 2—6 longer than the others; gills of segments 7 and 8 short, with a broad base (Figure 319). Setae on abdominal segments 1—7 small, thin and dark; anterior-margin setae small, distinct on all the above segments; anterior-angle seta slightly larger, situated at the base of the stalk of the gill; a small secondary seta nearby; medioanal and intermediate setae larger than the others, very similar; small lateral seta of segments 1–7 situated at a distance from the above setae; all 4 setae on segment 8 (as on segment 9) form a row. Two pleural setae at the end of the stalk of the gill, directed upward; third pleural seta situated slightly more basally, among the terminal filaments. Narrow, oblong ellipses ventrally, near the anterior margin of the segment; 3 small ventral setae situated posterior to these ellipses, from the second segment onward, widely separated from each other.

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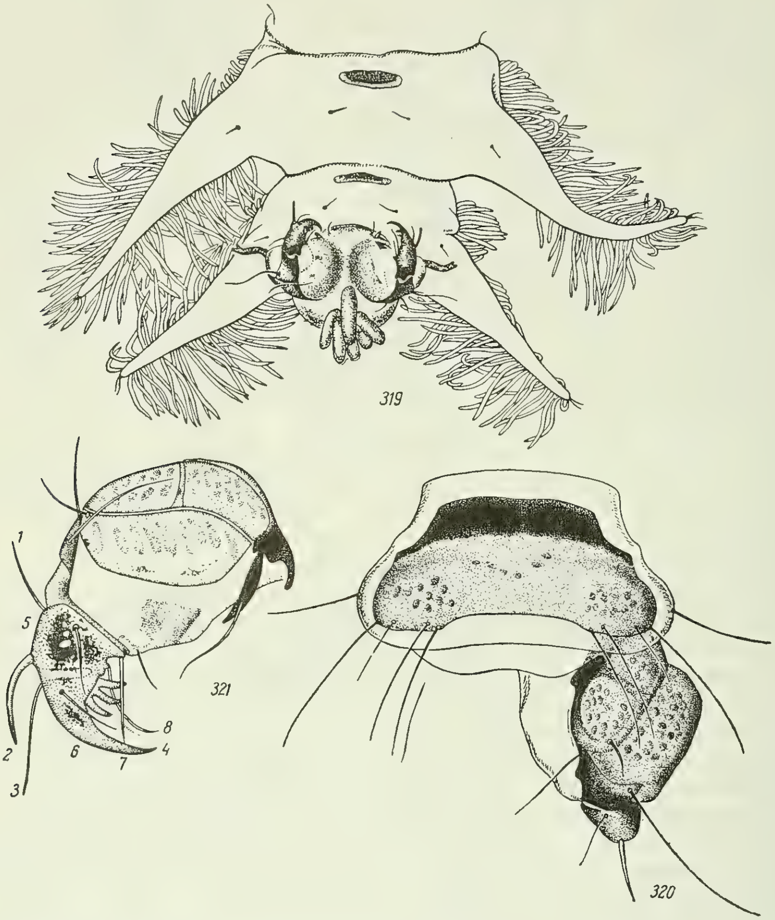

FIGURES 319–321. Himalopsyche gigantea Mart.:

319 – abdominal segments 7, 8 and 9, ventral; 320 – dorsal sclerite of abdominal segment and right anal leg; 321 – right anal leg (outer view).

Dorsal sclerite of segment 9 (Figure 320) light brown, with broad reddish dark brown anterior margin and a shallow notch posteriorly in the middle; lobes with 4 dark setae each; medioanal and anterior-angle setae moderately long and thicker than the others; intermediate seta situated near the median seta and almost as long as this, but thinner; lateral seta small, thin, situated near the anterior-angle seta; lateroventral seta large, dark and situated at the sides of the segment. Anal gills six in number, light and with a delicate pattern of brownish dots.

Anal legs (Figures 320 and 321) short and broad; dorsolateral sclerite "b" 284 strongly convex, with large dots and well-marked grooves; mediodorsal margin broad and reddish brown; basoventral hook with a black base and a reddish tip; basoventral sclerite black, with a reddish brown, slightly curved, strong, spinelike terminal process; seta light brown, relatively large. Distal sclerite of the dorsal part of the sclerite situated at an almost right angle to the median sclerite, dark brown in its greater part; it is indented distally but has no tubercle; outer seta relatively long; second distal seta situated in the mediobasal angle of the sclerite, short and brown; seta of the middle part also short but thicker and situated on a ridge. Ventral plate of sclerite "c" small and yellowish; seta reddish brown, short and strong; outer plate large, irregularly triangular, reddish brown, with a dark dorsal stripe.

Claw (Figures 320 and 321) with a broad massive basal part, curved in the distal part, narrowed at the end, with 3–4 strong ventral spines; seta 1 285 situated at the base, thin, yellowish, small; seta 2 situated above the suture, in form of a short, reddish brown, thick and weakly curved, blunt spine which is slightly flattened and movably articulated in its pit; seta 3 situated dorsally, further distally, above the suture, and long; outer seta 5 similar but darker; seta 6 markedly shorter; ventrally, in the basal part stand the light, thick setae 7 and 8; seta 8 situated on a tubercle, curved, longer than seta 7 and divided; on the inside, nearby is the thin light and similarly long seta 4.

**Young larva.** Second-stage larva 7 mm long, with branchial stalks, but no filaments on the thoracic and abdominal segments; as always in young larvae, the setae (including the 3 pleural setae at the tip of the stalk of the gills) are relatively long.

**Pupa.** Unknown; pupal case built before pupation from large sand grains and a few small stones; widely open ventrally, with relatively smooth walls and numerous openings.

Mode of life and habitats. Cold-water streams in high mountains.

Distribution. USSR: mountains of Middle Asia.

### 2. **Himalopsyche** sp. "larva hoplura" Lepneva *

Lepneva, 1945:72–73; 1960:107–108; 1963:64–66.

**Full-grown larva.** Closely related to H. gigantea in general habitus and a number of characters; smaller, length 20–22 mm; head not so short, slightly longer than broad. Mandibles with only one basal tubercle above the acetabular pit (Figure 322); small tubercles on the outer side of the right mandible, anterior and posterior to the setae; they are absent on the left mandible. Punctate pattern on legs indistinct; dark stripe on the tibiae and tarsi absent.

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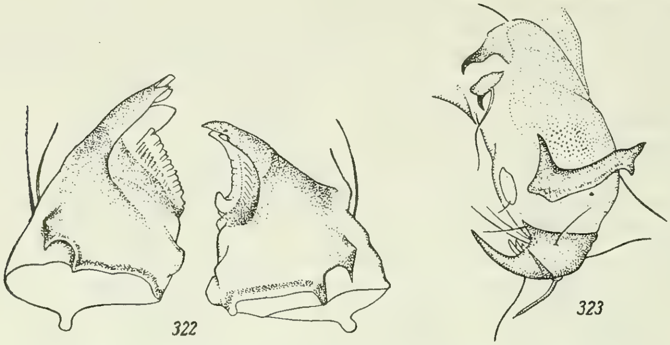
* The larva described as Himalopsyche sp. "larva hoplura" possibly belongs to H. kuldschensis Ulm. from the part of the Dzhungar Ala Tau adjacent to the USSR and from West Tibet and Pakistan (Lepneva, 1958a:40–42; Schmid, 1958:220).



FIGURES 322 and 323. Himalopsyche sp. "larva hoplura" Lepn.: 322 – mandibles, dorsal; 323 – outer view of right anal leg.

Anal legs (Figure 323) of both species of Himalopsyche similar in the area of sclerite "b," There are marked differences in the structure of section "c"; ventral sclerite "c" light brown as in H. gigantea, with a strong dark seta; outer lateral sclerite triangular, with a broad, dark brown stripe posteriorly and a massive outward-directed process which is divided like a fork and curved ventrally. Unlike H. gigantea, claw ventrally with 3 thin small spinules; seta 2 dark brown, movable, flattened, larger than in H. gigantea.

Mode of life and habitats. High-mountain, cool-water streams.

Distribution. USSR: mountains of Middle Asia.

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### 3. Genus **Philocrena** Lepneva

**Full-grown larva.** Medium sized; length about 18 mm; not dorsoventrally flattened, slightly broader posteriorly. Primary setae are short except setae of anal legs, some of them reduced in size. Head not completely prognathous, slightly inclined downward; gular suture not longer than coronal suture. Frontoclypeus with deep lateral notches; lateral anterior-margin seta situated in the angles of the sclerite; unlike in Rhyacophila, it is situated inside and not lateral to the frontal suture. Segments of maxillary palps uniformly developed; 2nd segment shorter than first segment. Pronotum without a light anterior-angle notch which is characteristic for the species of Rhyacophila. Trochantin of meso- and metathorax differentiated. All 3 pairs of legs very similar. Dorsum of abdominal segments rugose; anal legs large; lateral sclerite "b" without sword-shaped distal process and with a large basoventral hook; second hook situated nearby on a small sclerite. Claw is unusually long, with strong and long setae.

Mode of life and habitats. Mountain brooks originating in springs.

Distribution. USSR: Transcaucasia, Trialet Range. Not recorded outside the USSR.

### 1. **Philocrena trialetica** Lepneva

Lepneva, 1956:900—911, Figures 1—11.

**Full-grown larva.** Length 18.0—18.5 mm; body narrow and long (Figure 324); the body widest in the posterior part of the abdomen, in the region of segments 6 and 8; chetoids of the sclerites form short rows of dense groups of 3—4, rarely 5—8 setae (Figure 326); the tufts of chetoids appear like dark dots under low magnification.

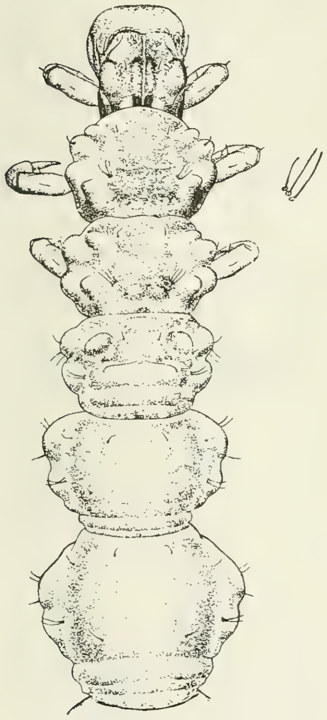

FIGURE 324. Philocrena trialetica Lepn. Full-grown larva, dorsal: head, thorax and abdominal segments 1—3

Head (Figure 325) short and broad; main color of sclerites yellowish, dark parts brownish. Frontoclypeus with a dark heart-shaped figure in the posterior part, with a transverse row of large light dots without chetoids;* anterior part of head with two large dark spots; groups of large dots at the place of the dorsal and lateral stripes.

All 3 anterior-margin setae are situated close together, near anterior angles of frontoclypeus; lateral and intermediate seta short and dark; median seta light, curved inward, along the margin of the sclerite, longer and thicker than the other two; anterior frontal seta similar and recumbent; median frontal seta situated near the curvature of the suture, small and thin; posterior seta short and light, slightly curved inward. Seta 9 situated near the anterior margin of the eye, long and dark; posterior to it is seta 11, which is thin and relatively long; seta 7 dark and slightly longer than seta 9; small light seta 10 situated lateral to the eye; posterior to this seta, the similar light but thick and small seta 13; farther posteriorly, the thin, recumbent seta 12 and the long, dark seta 14; seta 15 has an unusual form, it is short, thick, light and situated near the frontal suture, not posterior to seta 14 but slightly anterior to it; seta 16 situated in posterior part of head, light like seta 15, but longer; near the suture, anterior to the bifurcation, the unusually long,
287 curved, recumbent seta 17; a pit posterior to it. Ventral seta 8 situated near the anterior margin of the head, small, thick and brownish; seta 18 similar, shorter, situated far anterior to the bifurcation of the gular suture (Figure 329).

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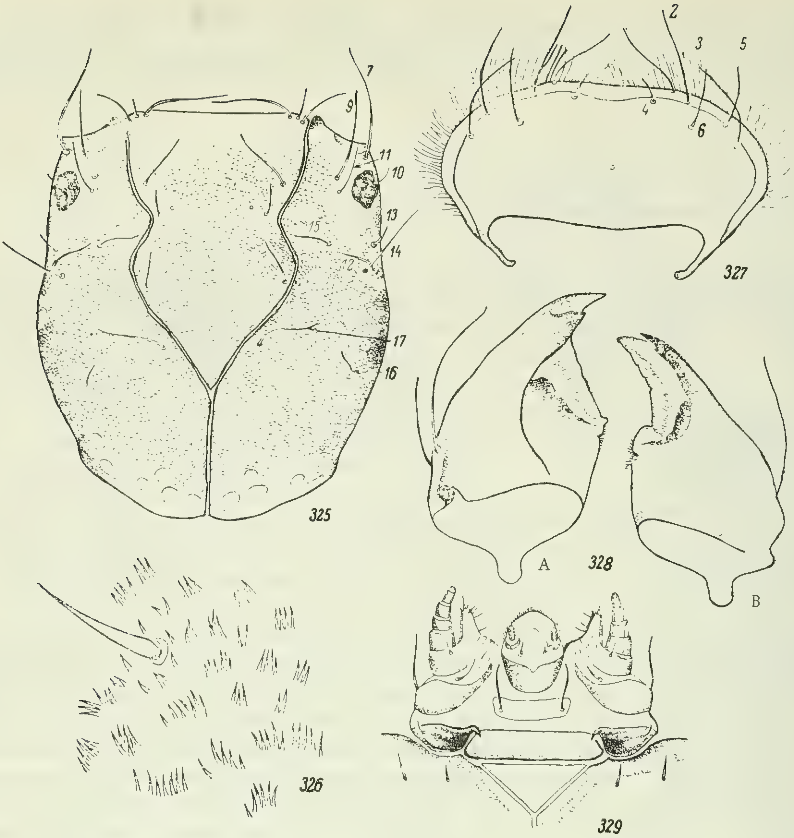
* There are no chetoids on dots and spots which indicate the place of attachment of muscles.



FIGURES 325–329. Philocrena trialetica Lepn.:

325 – head, dorsal; 326 – chetoids near seta 16; 327 – labrum; 328 – mandibles, dorsal: left mandible (A), right mandible (B); 329 – anterior margin of head, ventral: gula, pregula and maxillolabium.

Dorsal sclerite of labrum (Figure 327) golden yellow, brownish posteriorly; outer membranous border of the labium with dense whitish hairs; the light, curved seta 1 is situated among these hairs; the small seta 4 is situated in a median depression on the margin of the sclerite;; seta 2 situated on a membrane near the margin of the sclerite, dark brown and slightly curved; seta 5 is the same; the light, inward-curved but not recumbent seta 3 is situated slightly posteriorly on the membrane; seta 6 situated more toward the middle.

Mandibles (Figure 328) short and yellowish, with dark ends; the apex of the left mandible, in addition to the apical tooth, with a projecting large subapical tooth of the reduced upper blade; serrated section with small toothlike processes at the sides. Right mandible bifid at the end; upper tooth shorter than the lower; lower blade with a large blunt basal tooth;

near the base of the lower blade of the mandibles are several minute pointed spinules which are more distinct on the right mandible. Outer 288 setae of mandibles situated close together; distodorsal seta light and curved, longer than the straight dark basoventral seta.

Pregula trapezoidal, with straight, anterior margin (Figure 329); cardo dark brown, blackish in the middle, light anteriorly, with a short dark seta; maxillolabium and submentum yellowish brown, transversely oblong, with rounded posterior angles; unlike in Rhyacophila, the seta is situated in the posterior angle; it is thin, light, long, very thin at the end; stipes relatively broad; basal seta situated on a sclerite; distal seta shorter and situated on a membrane; both setae light. Palpiger with a transparent, light distal seta and a small basal seta; maxillary palps (unlike in Rhyacophila) with short broad segments which differ little in length; 2nd segment slightly shorter than first; galea shorter and not as narrow as in Rhyacophila. Mentum curved like a cup, large, without median suture; ventral sclerites small, with a light seta; labial palpiger horseshoe-shaped; labial palp thick and well developed as in Rhyacophila.

Pronotum (Figure 324) yellowish brown, darker in some places; anterior margin projecting, with a narrow reddish brown border; instead of the light colored notch characteristic for Rhyacophila, a small tubercle with a short, strong dark primary anterior-angle seta near the anterior angle; lateral margin curved inward in the anterior quarter, with a narrow brownish border; other part of lateral margin with a broad dark brown border which becomes broader posteriorly; posterior angles distinct but not long; suture with a dark posterolateral border in the middle which projects in form of pointed angles at the sides of the suture; posterior margin blackish brown, uniformly broad. Sclerite with two narrow longitudinal ridges near the suture; tubercle in form of an Ancylus shell with the apex directed anteriorly at the sides of each half of the sclerite; this tubercle bears several light spots without chetoids. Lateral to the primary anterior-angle seta 1 is a secondary seta, to its inside stands seta 2; small light inward-directed setae at the anterior margin of the sclerite; one of them situated near the median suture, straight, light and longer; 3 straight, short and thin setae situated slightly away from the margin; a short, light thick seta situated in a depression between the median and the hook-shaped tubercles; second seta similar and situated on the apex of the hook-shaped tubercle; third seta situated laterally near the base of the tubercle; 2 short dark setae laterally;and several small setae in the anterior-angle region.

Unlike in Rhyacophila, meso- and metathorax (Figure 324) are not broader posteriorly; anterior margin of mesonotum projecting anteriorly as a thick membranous fold; dorsum of segments divided by a transverse groove into an anterior and a posterior part; each part with two hillock-shaped tubercles at the sides; middle of the posterior part with light dots. Dorsal setae small, dark at the base, situated on small yellow sclerotized dots; anterior-margin setae of mesonotum slightly larger than those of metanotum; anterior-angle setae situated near apex of anterior lateral process; surface setae form an oblique row near the base of the tubercle; all 3 groups of setae of about the same size.

Pleuron of the prothorax (Figure 330, A) with a broad black longitudinal pleural groove; episternal region reddish brown, with indistinct yellow spots; epimeral part of sclerite darker and smaller; epimeral seta situated

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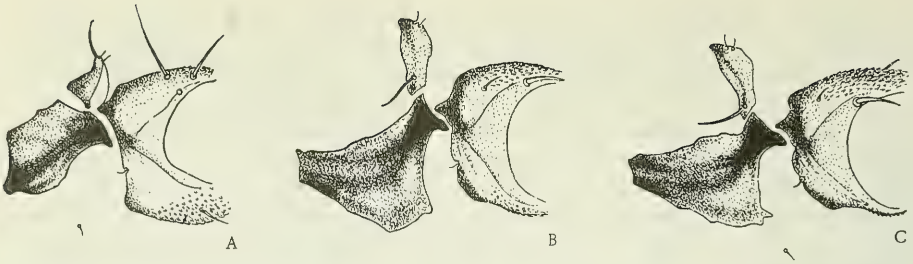

FIGURE 330. Philocrena trialetica Lepn. Pleural sclerites of thorax and base of coxa: prothorax (A), mesothorax (B) and metathorax (C)

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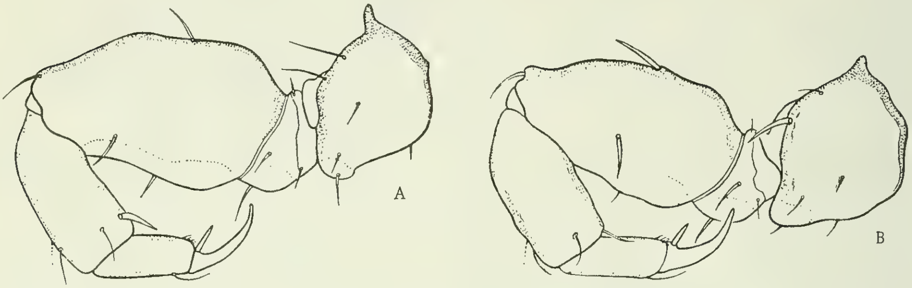

FIGURE 331. Philocrena trialetica Lepn.: anterior view of right foreleg (A) and right hind leg (B)

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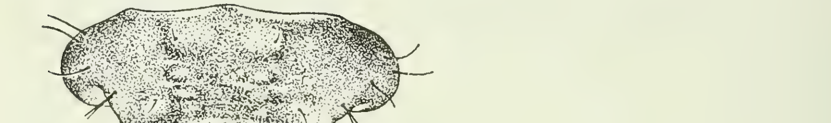

FIGURES 332 and 333. Philocrena trialetica Lepn.:

332 — abdominal segments 8 and 9 and anal leg, dorsal; 333 — abdominal segment 9 and anal legs, ventral.

on a membrane, reddish brown; the free trochantin short and conical, with a dark brown sclerite; seta situated on the membranous apex, on a separate sclerotized dot; both setules dark and situated on a membrane. Pleurites of meso- and metathorax (Figure 330, B and C) (unlike in Rhyacophila) in the episternal-epimeral section are arranged as on the pleuron of the prothorax; the only difference is that the epimeral part of the meso- and metapleuron is larger than the episternal part and the seta of the epimeron is situated on a membrane, and is small, thin and dark; sclerite of trochantin of both segments (unlike in Rhyacophila) not fused with episternum, differentiated in form of a small oblong plate; seta of trochantin light brown and strong, situated near the posterior margin of the sclerite; both setules situated distally.

Legs (Figures 324, 331) short, very similar in size and form; the forelegs slightly longer than midlegs and hind legs; chaetotaxy of the legs, except the dorsal setae of the coxa, also similar; most setae are short; some of them thick; ventral setae partly reduced in size.

Coxae of all legs short, with a broad distodorsal notch on a small projecting membranous distoventral part; coxae with a narrow reddish brown border dorsally at the base. Anterodorsal setae of coxa of the forelegs dark brown and strong; basal seta longer than distal seta; distodorsal seta of midlegs and hind legs forms a massive brownish spine; basodorsal seta short, thin and yellow; both anterior setae small, dark, strong; posterodorsal seta brown and short, displaced to the posterior part
289 of the coxa; anteroventral seta situated at the apex of an inflated membranous area, small, light, larger on forelegs than on midlegs and hind legs; posteroventral seta the same, but unlike in Rhyacophila, situated distinctly further basally, in about midlength of the segment. Basal margin of coxa with 4 setules: 2 dorsal, 1 anterior and 1 posterior.

Trochanter short, not closed dorsally; its distal part with a wide rounded membranous ventral area covered with a dense brush of minute, light spinules; basal margin reddish brown; anterodorsal angle pointed, with a dark setule. Anterior and posterior setae short; the former thick and brown, the latter lighter, thin and curved; trochanter with three setae ventrally: a relatively long, light posterior subapical seta on the membrane (on a sclerotized dot); a second, posterior seta situated further basally, also situated on a membrane; this seta is very small, but thicker than a setule, blunt, light and hardly distinguishable among the chetoids; an anterobasal seta situated near the suture; it is small and dark.

Femur broadly membranous ventrally, with four large spots without setae posteriorly and dorsally. Distodorsal seta light, short, curved posteriorly, brown, spinelike, smaller and thinner on the forelegs than on the midlegs and hind legs; posterior and anterior setae short and brownish; the former thin and situated subapically; the latter spinelike, situated subventrally near the distal margin on the forelegs, situated further basally on midlegs and hind legs, closer to the middle of the femur; posteroventral seta situated on a membrane near the margin of the sclerite, yellowish, strong, pointed and situated in about the middle of the segment; anteroventral seta situated further basally, very small, light and hardly visible among the small covering chetoids.

290 Tibia dorsally with large light spots without setae; all 6 setae are situated dorsally near the apex, at the sides and ventrally; both dorsal setae

situated subapically, short, light and thin; anterior seta curved; second situated further basally and straight, thinner and smaller on the forelegs than on midlegs and hind legs; seta on the anterior surface light; seta on the posterior surface brownish and curved; both setae short and thin; distoventral setae spinelike, brown; anterior seta shorter than the posterior seta.

Both dorsal setae of tarsus light, curved, situated at the sides of the claw; distoventral setae small, indistinct; near them are several even smaller spinules. Claw large, brown, almost as long as the tarsus; basal seta forms a blunt, thick spine.

Abdominal segment 1 resembles the meso- and metathorax in form; its dorsum stands in relief and is divided by a transverse groove into an anterior and posterior part; two tubercles at the sides of the anterior part; one tubercle at the sides of the posterior part; dorsum of anterior part with a pattern of light spots; two transverse folds in the posterior part. The abdomen becomes broader from the 2nd to the 7th segment; segment 8 slightly narrower than 7; anterior part of the dorsum with a pattern of light stripes and dots, posterior part with three narrow, transverse folds; sides of the segments with 2 processes, one in the anterior and one in the posterior part; they are fused in their greater part, forming a single process with a double apex; the bifid appearance becomes indistinct on segments 6—7; the process is not bifid on segment 8; segment 9 without process; dorsum of segments 6—8 with a narrow median stripe the sides of which are covered with small tubercles, 4 on each segment: one in the anterior part and one on each of the 3 transverse folds of the posterior part; these tubercles are larger on segment 8 than on the other segments. Abdominal setae dark and short. Anterior-margin seta on segments 1—8 small and strong; anterior-angle seta thin, small, situated between 2 tubercles on segment 1 (Figure 324); situated slightly median to the lateral tubercle on the other segments; slightly displaced posteriorly on segment 8, closer to the anal setae; medioanal seta curved inward and situated on a fold of the posterior part; intermediate and lateral seta situated close together and situated at a distance from the medioanal seta, near the base of the lateral tubercle. Pleural setae 3 in number (2 primary and 1 secondary), situated at the apex of the tubercle of the anterior part; primary setae situated one behind the other; a secondary seta situated nearby and thinner; segment 8 with 2 relatively large pleural setae. Ventral setae of segment 1
291 small, strong, dark, situated on sclerotized dots in the anterior part of the segment; median and lateral setae situated near the anterior margin; intermediate seta situated posterior to them, closer to the median seta; arrangement of setae similar on segments 2—3, but the distance between them is greater; lateral seta displaced laterally, to the margin of the anterior tubercle, situated more ventrally and posterior to the pleural setae; intermediate seta displaced farther posteriorly; lateral seta on segment 4 situated posterior to the pleural setae, at the boundary between the anterior and posterior fused tubercles; it is displaced on segments 5—7 to the posterior part of the tubercle; all 3 ventral setae on segment 8 larger than on the preceding segments, thick, situated on small brown disks; lateral seta situated on a tubercle posterior to the pleural setae.

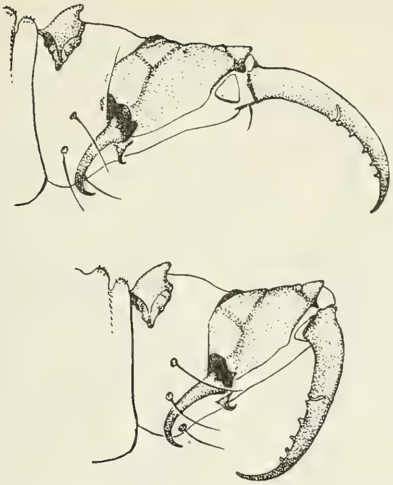

FIGURE 334. Philocrena trialetica Lepn. Anal legs in different positions

Segment 9 (Figure 332) without lateral processes, but not narrower than the posterior part of segment 8. Dorsal sclerite brown, broad, with blackish brown anterior margin; it is dark brown where chetoids are numerous; a wide process in form of an Ancylus shell with the apex posteriorly in the middle; this process has groups of large indistinct spots without setae at the anterior margin and laterally. Anterior-margin setae of segment 9 small and thin, situated on a membrane near the black margin; medioanal setae short, light brown, thin and situated at the posterior margin, lateral to the median tubercle; intermediate and lateral setae situated close together, at a distance from the medioanal seta; anterior-angle seta light brown, short, situated laterally, in a row with the anal setae. The 3 ventral setae large, dark and strong, situated on a convex brown sclerite; lateral and intermediate setae situated at the sides of the segment.

Anal legs (Figures 332 and 333) very long and highly specialized. Dorsolateral sclerite yellow, with a broad, black, median border and a narrow, basal border; sclerite divided by grooves into three parts: a divided, basal part, a lateral part and a distal part; each part with groups or rows of dark reddish brown spots; these parts bear numerous dark chetoids, Unlike in Rhyacophila, there are two basoventral hooks: the first is homologous to the hook of species of Rhyacophila; it is situated in the angle of the sclerite, very large (Figure 334), and with a black border at the base and a reddish brown end; second hook much smaller, situated on the median side of the dark basoventral plate which bears a short, light seta and a small, outer, beak-shaped process. Dorsal tubercle of distal part of the sclerite with a rounded apex directed toward the side of the claw; this tubercle has a dark basal border; both setae of the distal part are short and light, one situated on the outer side and the other medially; 3rd seta of sclerite (unlike in Rhyacophila) not situated in the basal part but in the dorsal angle of the lateral part, also short, yellowish brown and curved. Ventral plate of sclerite "c" brownish yellow, with a black median border;

292 seta short and dark; lateral plate of this part larger, yellowish and with a narrow, reddish brown, oblique, basal stripe. Median membranous surface of segment dark in a large part because of the numerous chetoids.

Claw (Figures 332, 333, 334) very long and narrow, weakly curved; transverse membranous stripe situated in about the middle of the claw; the basal border narrow; basodorsal process low; claw covered with dense chetoids as the other sclerites of the larva; distal part with 5 strong, blunt and short reddish brown spinules ventrally. Dorsal seta 1 situated at the base of the claw, light, thick, very long, directed posteriorly, recumbent on the claw; dorsal seta 2 similar but shorter, situated slightly laterally, near the transverse membranous stripe; setae 4 and 5 are situated on the outer side and medially; they are similar to seta 1 and extend almost to the apex of the claw; long ventral seta 8 curved, basal seta 7 shorter; the short light setae 6 and 3 are situated one behind the other in the distal part on the outside; seta 3 situated close to distal margin of claw. When the claw is bent, it touches the ventral hook of the leg, forming a loop with which the larva grasps stalks of moss or other material, holding itself or hanging in the current; the second hook and the beak-shaped process of the basoventral plate are additional tools of support, instead of the sword-shaped process.

Mode of life and habitats. High-mountain spring brooks, among stones overgrown with moss.

Distribution. USSR: Lesser Caucasus, high-mountains of the Trialet Range. Not recorded outside the USSR.

## Subfamily HYDROBIOSINAE Ulmer

**Full-grown larva.** Size of larvae varying from 6.5–10.0 mm to 22–28 and even 30 mm;* live specimens are green or opaline white. Head, especially anteriorly, dorsoventrally flattened; frontoclypeus without deep lateral notches; gula small. Prothorax narrower posteriorly; pronotum wide; legs situated near the anterior margin of the segment. Meso- and metathorax much larger than the prothorax. Forelegs highly specialized, with an oblong rodlike coxa and very short, sometimes fused tibia and tarsus; with rare exceptions, the femur has a large distoventral process which forms a chela with tibia and tarsus (resembling the chela of Crustacea), or (as in species of Apsilochorema) femur, tibia, tarsus and claw have a different structure. Midlegs and hind legs long, thin and normal. Abdomen of small species almost cylindrical; it is slightly flattened ventrally in large species. Tracheal gills absent. Larvae are without case. One genus in the USSR.

Mode of life and habitats. Various types of flowing water.

Distribution. USSR: Middle Asia, Far East. In addition: southern Asia, Australia, New Zealand, North and South America.

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* Only small species occur in the USSR.

## 4. Genus **Apsilochorema** Ulmer

The larva of only one species is known in the USSR.

Mode of life and habitats. Brooks and rivulets with cool water.

Distribution. USSR: Middle Asia, southern part of the Maritime Territory; rare. In addition, southern Asia, New Guinea.

### 1. **Apsilochorema sutshanum** Martynov

Levanidova, 1961:211–215, Figures 1–4.

**Full-grown larva** (Figure 335).* Length 8–9 mm; abdomen much broader than head and thorax. Head yellow, without pattern; eyes small, situated near anterior margin of head (Figure 336). Frontoclypeus (as in Psilochorema) (McFarlane, 1951:283–286, Figures 72–95) irregularly triangular, narrower posteriorly; frontal sutures uniformly curved in the anterior part; tentorial pits little marked; gula small, triangular, fused with the pregula, which is larger 293 (Figure 337). Anterior-margin setae small; lateral seta situated in the angles of the sclerite; transparent, light, curved inward; intermediate seta straight, situated near the lateral seta; median seta situated at a distance and directed inward; anterior and middle frontal setae small, situated nearby in the anterior part of the sclerite; posterior frontal setae long and dark. Seta 9 situated near the anterior margin of the head, relatively long and dark; the thin, small seta 11 displaced from seta 9 and situated more ventrally; seta 7 shorter than seta 9, similarly strong and dark; seta 10 small, directed posteriorly; the short, yellow seta 14 is situated posterior to the eye; the short, light seta 15 is situated at the level of the tentorial pit near the frontal suture. The long, strong and dark seta 16 is situated further laterally; the short, ventral seta 8 is situated at the anterior margin of the head. The other setae were lost.

Labrum short and broad.

Mandibles (Figure 338) flattened, with only distal teeth; upper blade of left mandible with 3 small teeth and a large pointed middle tooth on the outside; lower blade marked only in the anterior part and with 2 small distal teeth; upper blade of right mandible with 4 small teeth in addition to the apical tooth; short lower blade of

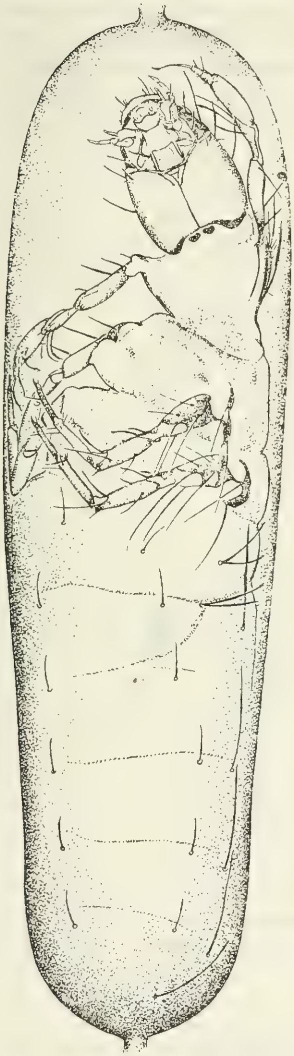

FIGURE 335. Apsilochorema sutshanum Mart. Full-grown larva in pupal cocoon, ventral

right mandible with 2 small teeth; distal outer seta curved, light, situated in about the middle of the mandible; basal seta shorter, straight and dark.

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* This description is based on one specimen taken from a pupal cocoon, and on several sclerites from the pupal case of another specimen.

Submentum wide, irregularly square, with slightly concave anterior margin and projecting anterior angles; setae relatively large, situated in the middle of the sclerite (Figure 337); cardo short and irregularly trapezoidal; the stipes forming a thin yellowish plate with indistinct outer margin and a curved, distinct, brown median margin; basal seta of stipes dark, large, situated on a membrane; short distal seta situated on a sclerite. Maxillary palpiger light; distal seta situated on the membrane straight and long. First and 2nd segments of the maxillary palps small, the 3rd longer than the others, the 4th is also long. Galea cylindrical and narrow; its setae relatively large. Mentum broad and brown; ventral sclerites with small light dots with short setae; labial palpiger very narrow and curved; labial palps large.

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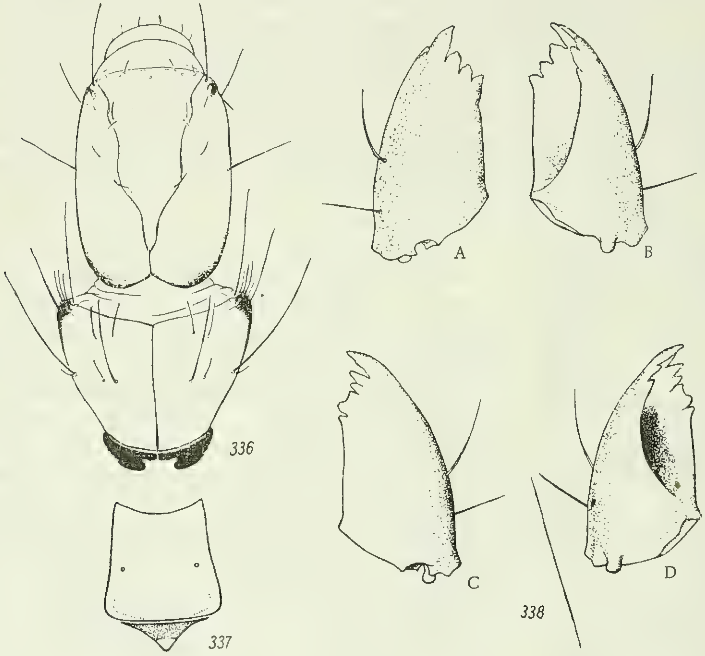

FIGURES 336–338. Apsilochorema sutshanum Mart.:

336 – head and prothorax, dorsal; 337 – gula, pregula and submentum; 338 – mandibles: left mandible, dorsal (A), left mandible, ventral (B); right mandible, dorsal (C) and ventral (D).

Pronotum (Figure 336) light, yellowish white, much narrower posteriorly than anteriorly, with a broad black posterior margin; lateral margin reddish brown, divided into two narrow stripes by a longitudinal, yellowish white stripe; a small dark spot near the anterior angle near which is a small,

light notch; the sclerite bears a long anterior-angle primary seta near the notch; a dark spot with 5 small thin setae and one short dark seta on the outer side; a small seta on the inner side. Each half of the sclerite with 2 short thin setae near the anterior margin; a long medioanal seta and a small seta near it in the posterior part, on the outer side; a similarly long dark seta at a distance from the lateral margin; nearby, a small light seta on
294 the outer side. The integument on the ventral side of the prothorax is thickened.

Meso- and metathorax (Figure 339) much broader than prothorax; membranous surface of thoracic segments of fixed specimens pinkish violet, with a distinct, light pattern; anterior-margin setae (unlike in Rhyacophilinae) well developed on meso- and metanotum, moderately long; anterior-angle and medioanal setae black, long, and strong; intermediate and lateral surface setae small, situated at the base of the median seta.

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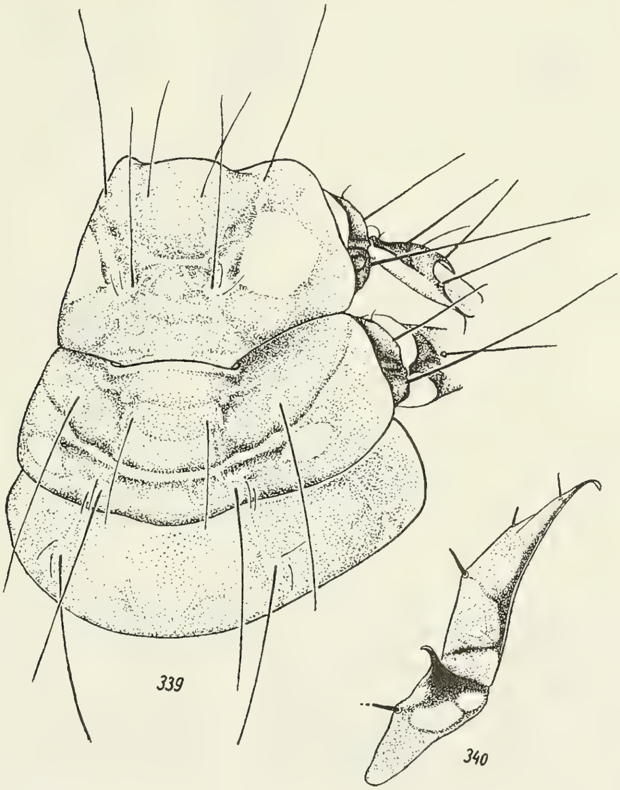
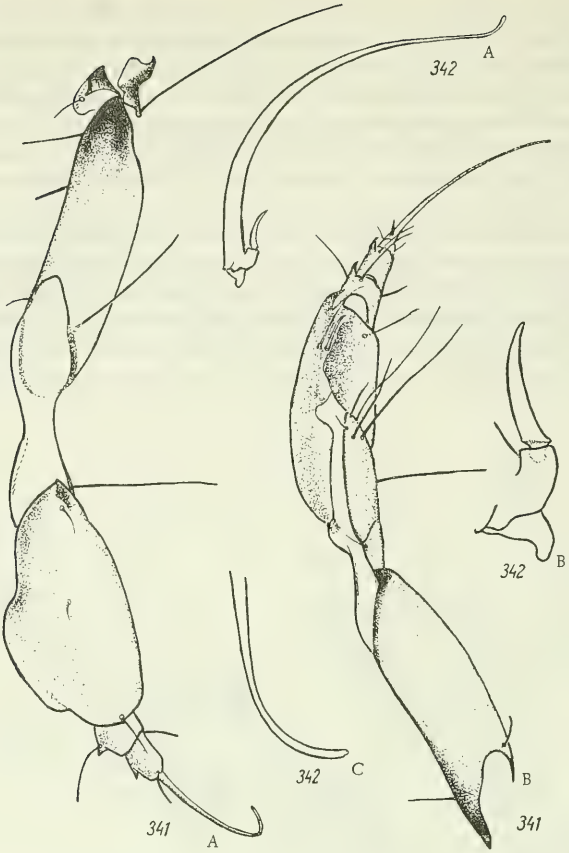


FIGURES 339 and 340. Apsilochorema sutshanum Mart.:

339 – mesothorax, metathorax, abdominal segment 1, pleural sclerites and base of coxae, dorsal; 340 – left pleural sclerite of mesothorax.



FIGURES 341 and 342. Apsilochorema sutshanum Mart.:

341 – foreleg, dorsal (A) and foreleg in ventral and slightly anterior view (B); 342 – claw of foreleg (A), base of claw (B), distal end of claw (C).

Coxa of forelegs (Figure 341) oblong, rodlike, with a small, narrow, beak-shaped process wedged between episternum and trochantin; this, together with the position of the coxa near the margin, ensures the high mobility of the forelegs. Distodorsal notch of coxa shallow; posterodorsal 295 seta long, situated near the margin of the notch; both anterior setae situated much farther basally, strong and dark; basal seta situated near the base of the segment; apical seta situated nearby and shorter; both anterior setae small and situated subdorsally; a large curved setule ventrally near the base; distoventral setae lost.

Trochanter narrow at the base and completely sclerotized ventrally. It has a small basal part separated by a suture; it is broadly membranous dorsally and the dorsal margin of the sclerite is uniformly rounded. Anterior seta small and light; posterior seta dark and long; both posterior ventral setae similar, one of them situated subapically; the distal anterior ventral seta is light, spinelike; middle seta situated near the posterior setae; basal seta situated near the suture of the sclerite (Figure 341).

Femur strongly deformed, flattened dorsoventrally, very convex dorsally (especially in the basal part); ventral surface flattened, slightly concave and sclerotized near the anterior margin; membranous part small, present only near the base; margin of femur projecting anteriorly in form of a crest at the boundary with the ventral surface; it projects like a beak distally; two ventral setae situated close together further basally; one spinelike and short, the second longer and light; posterior seta short and situated subventrally; basodorsal seta small, situated in the middle of the segment; distodorsal seta short; an additional small seta near the base.

296 Tibia short, with a deep, basoventral notch, with a distal beak-shaped process like the femur; all 6 setae present; one of the distoventral setae light and longer than the others.

Tarsus also short and with a distal beak-shaped process; short dorsal setae widely separated, one ventral seta light and long.

Claw (Figures 341 and 342) extremely long, thin like a seta, blunt and slightly club-shaped at the end; basal seta in form of a short, strong, blunt spine (Figure 342, B).

Midlegs and hind legs thin, normal; some setae very long (Figure 335). Coxa (Figures 339 and 340) with a small distodorsal notch; all 3 dorsal setae black and long; basal seta situated near the base of the segment; the anterior and posterior apical setae situated at the sides of the notch; anterior surface setae situated one behind the other and large; distoventral setae small and thin, situated close together; posterior seta shorter than anterior seta.

297 Trochanter membranous dorsally; its dorsal angles clearly marked; subapical posteroventral seta long.

Femur not longer than coxa; anterior seta situated subapically and longer than the others; basoventral seta short; there is a longitudinal row of minute spinules further distally; both dorsal setae short.

Tibiae and tarsi straight, rodlike and narrow; setae near the distal margin small. Dorsal setae of tibia straight, thin, situated at the apex and subapically; ventral setae small and strong. Tarsus shorter and thinner than tibia; both dorsal setae situated subapically. Claw of normal form, thin, slightly curved, with a small basal seta.

Abdominal segments 1—7* of the same form: segment 1 shorter but not narrower than the following segments; anterior-margin setae small; anterior-angle setae (except the first segment) dark and very long, longer than the thoracic setae; they stand close to the anal seta on segments 6—7; medioanal seta as long as the anterior-angle seta; a small intermediate seta and a lateral seta on the outer side near the base. Pleural setae 2 in number and situated on a small light spot; one of them long, the second small and thin. Intermediate ventral seta small, distinct, situated on a yellow sclerotized dot near the anterior margin of the sclerite.

Pupal cocoon (Figure 335) straight, almost cylindrical in the middle; ends of the cocoon fastened to the wall of the thick pupal chamberlike case by strong strands; pupal chamber covered with coarse sand grains.

Mode of life and habitats. Brooks with cool water.

Distribution. USSR: Maritime Territory.

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* We could not examine segments 8 and 9 at the end of the body of the prepupa in our material; we mention only some setae of the eighth segment.

# II. Family GLOSSOMATIDAE Wallengren

**Full-grown larva.** Length 5–12 mm. Head broad and short, slightly lower than broad; dorsal surface larger than ventral surface. Frontoclypeus broad and long; lateral notches in the anterior half of the sclerite shallow. Eyes situated on light spots at the level of the lateral notches of the sclerite. Antennae situated anterior to the eyes some distance from the anterior margin, with 2 sensillae and 2 setules, one of them short and the other long. Dorsal setae displaced to the anterior part of the head, to the periocular area. Labrum broadly membranous anteriorly. Mandibles without teeth; left and right mandible with brushes in the middle; a group of feathered chetoids among the chetoids.

Pronotum wide, convex; prosternum well developed. Meso- and metathorax membranous dorsally or with small paired tergites; pleural sclerites large.

Legs thin and short.

Abdominal segments subcylindrical; tergite of segment 9 large, trapezoidal. Six anal gills. Anal legs short and massive, obliquely directed downward, with a small strong claw.

The larvae live in cases with a rooflike dorsal surface and a flat ventral surface.

**Pupa.** Length 3–8 mm. Antennae reaching the abdominal segments 5–8. Labrum with almost straight anterior margin; anteromedian seta much smaller than the 6 other setae. Mandibles symmetrical, with two teeth.

Presegmental plates of the holding apparatus on segments 3–7 or 4–7; postsegmental plates on segments 4 or 4 and 5.

Mode of life and habitats. Brooks, rivulets and rivers with clean water and currents of varying strength; mainly in rapid currents; on stones.

Distribution. USSR: European and Asian parts of the Soviet Union, in hilly and mountain landscapes. In addition, Europe, Asia, North and Central America, partly Africa and Australia.

## Key to Subfamilies

### Full-grown larva

1 (2). Medium-sized, 8–12 mm long; meso- and metanotum membranous without sclerites; claws of legs with a process at the base of the basal seta . . . . . . . . . . . . . . . 1. **Glossosomatinae** Ulm. (p. 323)

2 (1). Small, 6–7 mm long or less; meso- and metanotum with small lateral sclerites; claws without process at the base of the basal seta . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Agapetinae** Mart. (p. 336)

### 298 Pupa

1 (2). Length 6–8 mm. Outer setae of mandibles almost equally long; basal seta only slightly shorter. Presegmental plates present on abdominal segments 3–7, postsegmental plates on segments 4–5. Length of pupal case 8–11 mm . . . 1. **Glossosomatinae** Ulm. (p. 323)

2 (1). Length 3.5–6.0 mm. Basal seta of mandibles short and spinelike, much shorter than distal seta. Presegmental plates present on abdominal segments 4–7, postsegmental plates on segment 4. Length of pupal case 4–8 mm . . . . . . . . . . . **2. Agapetinae** Mart. (p. 336)

## 1. Subfamily GLOSSOSOMATINAE Ulmer

### Key to Genera

Full-grown larva

1 (2). Head and pronotum chestnut brown, without dots . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **1. Mystrophora** Klap. (p. 323)
2 (1). Head and pronotum yellowish brown or brown, with more or less distinct dots . . . . . . . . . . . . . . . . **2. Glossosoma** Curt. (p. 333)

## 1. Genus Mystrophora Klapálek

**Full-grown larva.** Length 8–9 mm. Sclerotized areas chestnut brown, without dots; dots visible only on the exuviae. Gula triangular, clearly differentiated; pregula forming a narrow, transverse stripe; submentum trapezoidal, with long anterior margin and short posterior margin. Pronotum with 3 oblique pale yellow dashes with setae at the sides. Meso- and metanotum without tergites. The pleuron of prothorax small, that of meso- and metathorax large. Legs thin; the three pairs differ little in length. Anal claw massive, short, with ventral spinules.

**Pupa.** Length 6–7 mm. Median seta of the 3 setae of the anterior margin of the labrum, smaller than the other two. Basal tooth of mandible small. Wing sheaths reaching abdominal segments 4–5. Presegmental plates present on segments 3–7, postsegmental plates on segments 4–5. End of body divided into two small lobes each with 3 setae.

Pupal case built of sand grains and small stones.

Mode of life and habitats. Mountain brooks, streams with rapids, on stones.

Distribution. USSR: northern part of the European USSR, southern Siberia, Kamchatka and Far East. In addition, northern and Central Europe, North America.

The following species occur in the USSR: Mystrophora altaica Mart., M. ussurica Mart. and M. intermedia Klap. Only the larvae of M. altaica Mart. are known. The larvae of M. intermedia were briefly described by Kimmins (1943); he does not even describe the coloration of the larva. It is not possible to give a key to the larvae of Mystrophora.

### 1. **Mystrophora altaica** Martynov

Lepneva, 1949:167.

**Full-grown larva** (Figure 343). Length 8—9 mm. Sclerites shining and dark; abdomen nearly cylindrical, slightly broader than the thorax. Head uniformly chestnut brown (Figure 344), slightly lighter near the occipital foramen and the coronal suture; gula small and triangular; gular suture short and slightly longer than gula. Eyes situated on a light area; antennae well developed, situated anterior to the eye; sensillae pale, with rounded apex; median seta relatively long, directed inward, reaching the frontal suture; second seta small. Frontoclypeus large, with a distinct posterior row of dots on the exuviae; median anterior-margin seta shorter than the others, light brown; intermediate seta dark brown, long; lateral seta at the angle of the sclerite light, curved inward. All 3 frontal setae situated close together; posterior frontal seta dark brown, thick, long and situated in the posterior part of the sclerite; middle and anterior frontal setae situated close together, at the curvature of the frontal sutures; the first short and light; the second transparent and recumbent. Large dots lateral to the epicranial suture and on the sides of the head are visible on the exuviae.
299 Setae present near the light periocalar area; seta 9 is the longest seta of the head; it is situated together with the short light seta 11 anterior to the curvature of the frontal suture, at the level of the middle of the eye; seta 7 is brown, strong, short and is situated posterior to the antennae, near the anterior margin of the light periocular area; the small, light and spinelike seta 8 is situated laterally, at the same level. The small yellowish seta 10 is situated lateral to eye and anteriorly; the small thin setae 12 and 13 are situated behind each other posteriorly; seta 14 is situated slightly more medially, the strong, moderately long, dark brown seta 15 is situated posterior to the periocular area, at the level of the eye; two pits medial to this seta; seta 16 is situated behind the posterior frontal seta, it is thin, transparent, curved inward and recumbent; lateral to seta 16 is the small seta 17; slightly posteriorly to this seta are 3 setules situated behind each other. Ventral seta 18 small, situated lateral to the gular suture. Gula small and triangular (Figure 345).

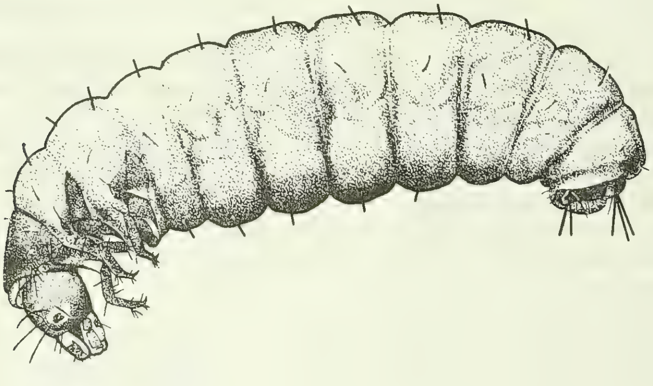


FIGURE 343. Mystrophora altaica Mart. Full-grown larva, lateral

Anteclypeus pale and oblong, with three indistinct, broad, longitudinal grayish yellow stripes. Labrum (Figure 346) with a broad outer membranous border; dorsal sclerite dark brown, slightly lighter near the anterior margin; posterior-angle sclerites blackish brown, rodlike; between them, at the posterior margin of the sclerite, a brownish, weakly sclerotized stripe; the sclerite bears anteriorly a small process in the middle and small notches laterally; anterior margin of the process concave. Seta 1 short, indistinguishable among the hairs; seta 2 situated on a membrane, curved and transparent; seta 4 situated near the angle of the median process of the sclerite; seta 5 brown, situated at the anterior margin of the sclerite; the shorter seta 3 situated near the angle of the sclerite; seta 6 dark, situated posterior to seta 4; median pit displaced to the right.

(300)

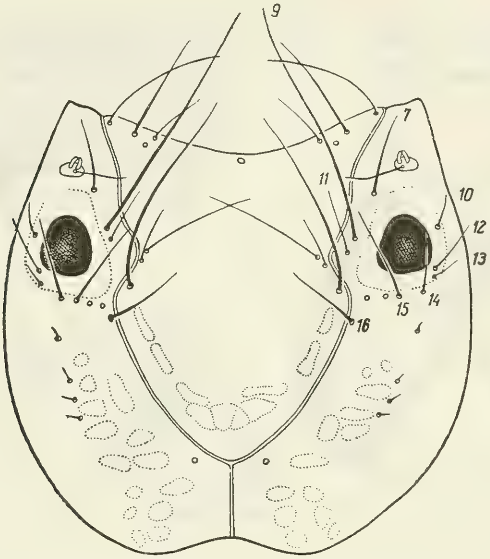


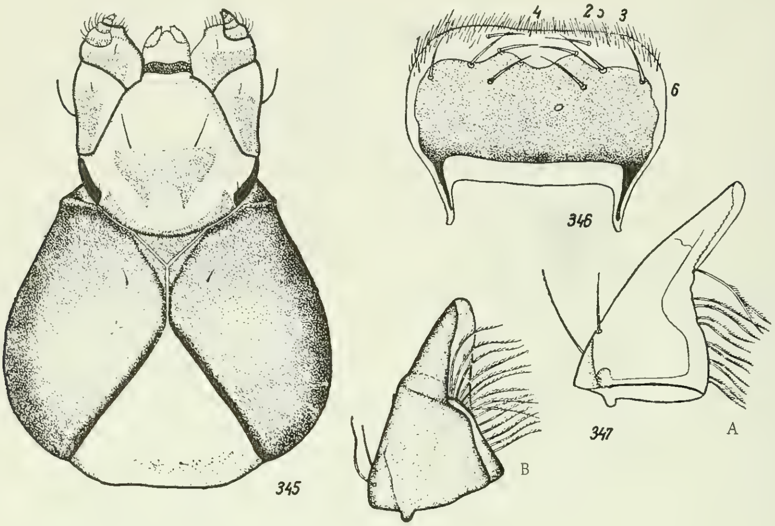
FIGURE 344. Mystrophora altaica Mart. Head, dorsal

Mandibles with a sharply marked transverse groove; median depression deep (Figure 347); blades without teeth; upper blade of the left mandible serrated; soft, thick feathered setae present in the median depression of the mandibles; outer setae of mandibles situated near the basal margin, close together; the most distal seta is light, small, the second strong, dark brown and long.

Maxillolabium oblong and massive; pregula narrow, transverse; the dark brown sclerite has a concave anterior margin and is broader than the gula. Submentum (Figure 345) broad anteriorly; its posterior margin with deep semicircular median notch and posteriorly-directed pointed lateral angles; setae near the anterior margin light brown and long. Cardo short; seta small. Stipes consisting of a ventral and lateral part; basal seta light brown, long and curved; distal seta situated near the anterior margin of the sclerite, small, light and spinelike. Palpiger relatively long and brown; distal seta light, situated on a membrane; mediobasal seta small; segments of palps short, with narrow, brown sclerites; galea broad and short. Mentum dark, blackish brown; ventral sclerites small; the light dots bear a short seta; sclerites of labial palpiger curved; labial palps relatively large; labium short.

Pronotum large, chestnut brown (Figure 348), its anterior margin projecting; lateral margin with a blackish brown spot where it is connected with the pleuron; lateral margin concave anterior to the spot; a wide process posterior to the spot; posterior margin of sclerite narrowly dark
300 brown; this border is divided laterally, passing around a light, elliptical broadening which bears large dots. Three yellowish brown, oblique dashes with setae on each side.

(301)



FIGURES 345–347. Mystrophora altaica Mart.:

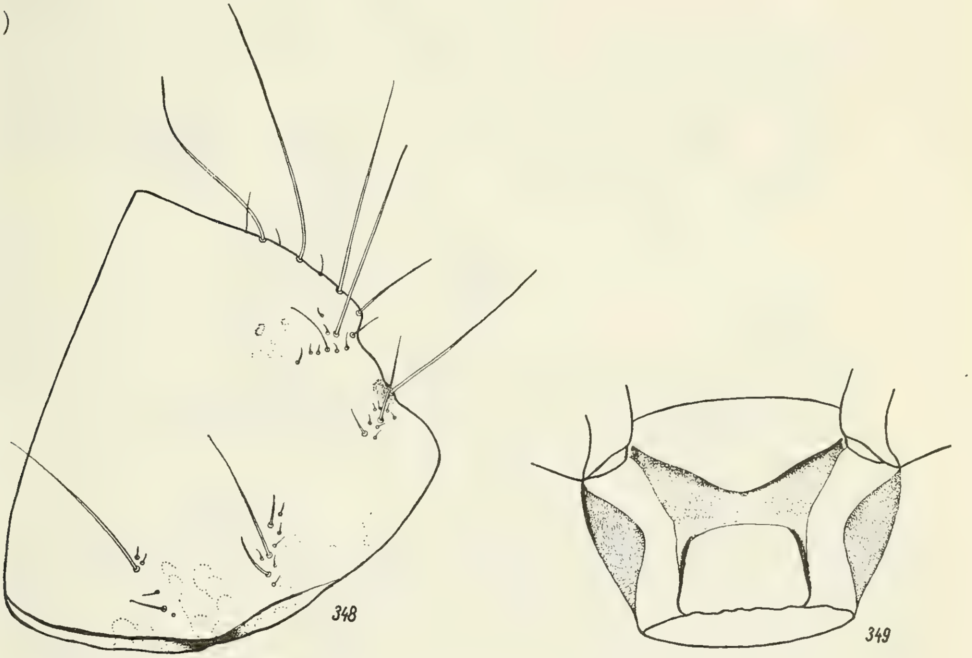
345 – head, ventral; maxillolabium; 346 – labrum, dorsal; 347 – mandibles: left mandible, dorsal (A), right mandible, ventral (B).

A thick, relatively long, primary anterior-angle seta is situated on a process of the anterior angle, slightly away from the margin; one of the 3 secondary short setae, situated at the angle, the other small, situated posterior to the former at the margin; 3rd seta situated posterior to the primary seta; several additional small light setae near the anterior angle. There are 3 laterally displaced, thick setae which are as long as the anterior-angle seta at the anterior margin; they are situated at the sides of the sclerite at an equal distance from each other; middle of the anterior margin without setae; 4 small light setae situated near the long anterior-margin setae and among them. The surface setae form three groups, a median, intermediate and lateral group; the first two groups are situated on the yellowish brown dashes. The first group consists of a brown, long, medioanal seta and 4 minute setae; the posterior of these setae is longer than the others; the intermediate group consists of a brown, thick, moderately long seta, a short seta anterior and posterior to it and 6 small light setae; the lateral group consists of 2 thick dark setae, one similar to the anterior-margin seta and situated on a black spot; the second is shorter and situated near the posterior margin of the spot; between the above setae and posterior to the second seta is a small seta and several very small setae.

Setae of mesonotum (anterior-angle, anterior-margin and medioanal seta) short, dark and thin; intermediate and lateral anal setae very small and light. Anterior-margin seta of metanotum smaller than that of mesonotum; other setae similar.

Pleuron of prothorax small, partly covered by the pronotum; trochantin and episternum fused. Sclerites of the pleuron of the meso- and metathorax large and brown; pleural suture black; the setae at the distal margin of the sclerite directed to the margin blackish brown; episternal seta strong and long; epimeral seta shorter and thinner.

(302)

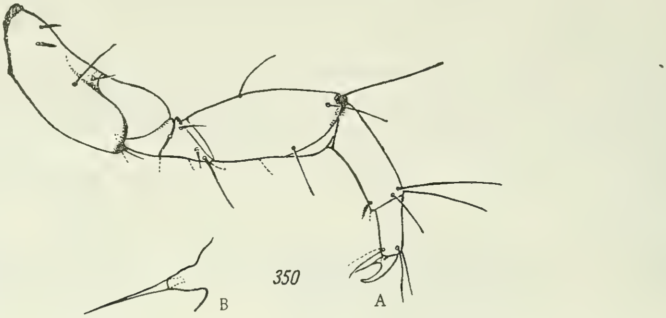


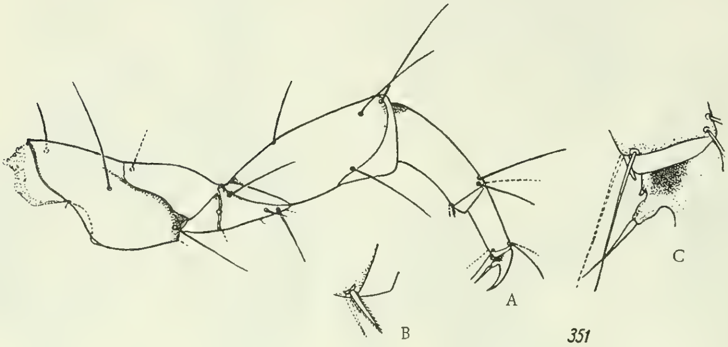
FIGURES 348 and 349. Mystrophora altaica Mart.:

348 – pronotum; 349 – prosternum.

Prosternum wide, brown, with a chestnut brown, narrow anterior margin (Figure 349); anterior angles prolonged; two indistinct yellowish brown spots in each half of the sclerite; sternite light in the middle, with a light stripe posteriorly; posterior angles prolonged in form of narrow, black rods which are very thin at the end. A small grayish brown sclerite at the sides of the anterior angles. Mesothoracic sternite divided, in form of two transverse rodlike sclerites. Metathorax membranous ventrally, without sclerites.

(303)





FIGURES 350 and 351. Mystrophora altaica Mart.:

350 — left foreleg, posterior (A), basal seta of claw (B); 351 — left hind leg, posterior (A), distoventral setae of tibia, posterior (B); distal end of tarsus and base of claw (C).

Distodorsal notch of the coxa of the forelegs (Figure 350) reaching the distal third of the segment; it reaches farther in the midlegs and hind legs. Basodorsal seta of coxa of forelegs thin, small; anterior distodorsal seta slightly longer, situated near the margin of the notch; posterodorsal seta situated in the middle of the segment, much larger than the anterior setae; both anterior surface setae thin and small; both distoventral setae light, spinelike, short; posterior seta slightly longer than the anterior seta. Basodorsal seta of coxae of midlegs and hind legs (Figure 351) strong and dark, long; anterior and posterior distodorsal seta even longer near the apex of the notch; the 2 anterior-surface setae are small and thin (as on the forelegs); anterior distoventral seta, light brown and small; posterior seta much longer, longer on the hind legs than on the midlegs. Anterior
301 and posterior seta of trochanter of forelegs small and thin; the posterior

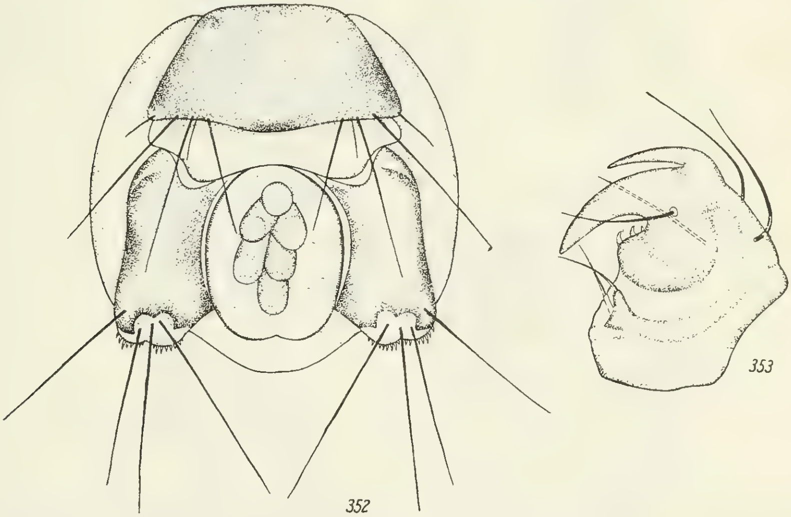
subapical seta of the 5 ventral setae thin, dark and long, the others spinelike and light; the posterior, dark brown surface seta near the dorsal angle of the trochanter of the midlegs and hind legs is long; anterior seta short and yellowish; ventral subapical posterior seta long and dark, the other 4 ventral setae light and spinelike.

Dorsal setae of femur of forelegs brown and long; basal seta shorter than distal seta; posterior seta short, situated subapically; anterior seta light yellow and small; posterior of the 2 ventral setae situated at the margin of the sclerite, longer than the light anterior seta which is situated further basally. Posterior setae of femur of midlegs and hind legs dark and long; other setae (except the basoventral seta) slightly longer than on the forelegs.

Setae of tibia and tarsus of all 3 legs similar, differing only slightly in length. Both distodorsal setae of tibiae situated behind each other, dark brown, relatively long; posterior seta situated subdorsally and also long; anterior seta shorter and situated closer to the ventral setae, which are small, light and spinelike (Figure 351, B). Dorsal setae of tarsi of all 3 pairs of legs dark, thin, almost as long as the claw; distoventral setae thin, slightly longer than those on the tibiae; they are soft, with a long thin end. Claw strong, blunt, with a short basal process and a transparent, spinelike seta (Figures 350, B and 351, C) at the apex.

First abdominal segment slightly smaller than the following segments; segments 3 and 4 are the largest. Anterior-margin setae of all segments small, little marked, setuliform; anterior-angle and medioanal setae thin, dark, distinct; intermediate and lateral anal setae small.

(303)

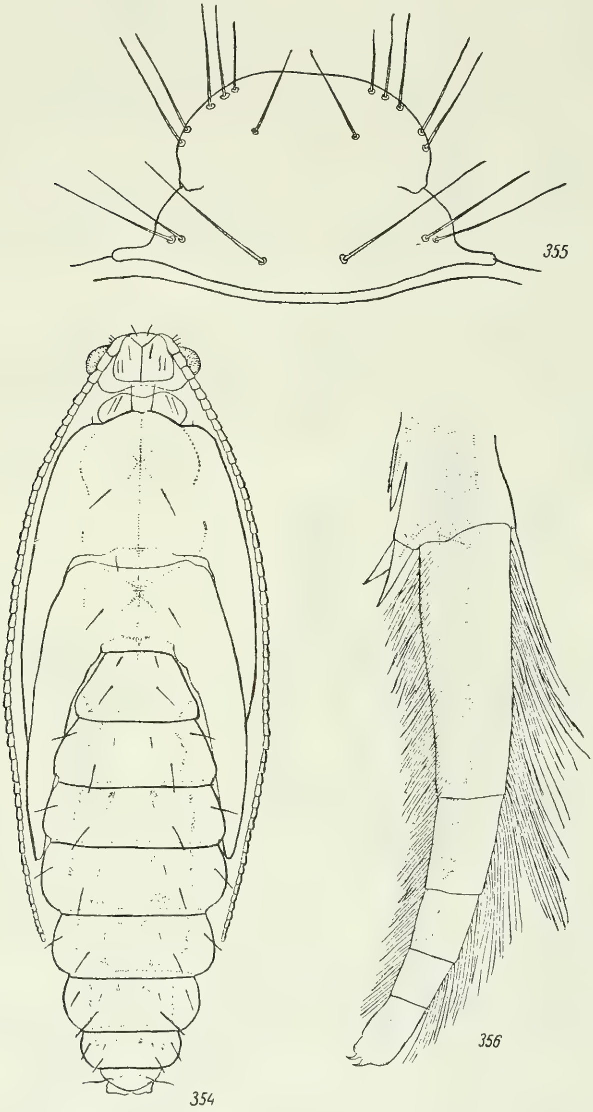


FIGURES 352 and 353. Mystrophora altaica Mart.:

352 – dorsal sclerite of segment 9, anal legs and anal gills; 353 – outer view of claw of right anal leg.

Sclerite of segment 9 trapezoidal (Figure 352), with a long convex posterior margin and a shorter anterior margin; anterior-margin setae small, brownish; setae at the posterior margin 5 in number and situated at the sides of the sclerite; 3 of these setae (medioanal, lateral and anterior-angle) thick, blackish brown and long; the thin intermediate seta stands near the medioanal seta; the strong, short, brown lateroventral seta near the posterior angle is displaced in the Glossosomatinae from the membrane to the margin of the sclerite. Folds of anal slit with narrow, longitudinal, dark brown, sclerotized, lateral stripes. Six anal gills.

(304)



FIGURES 354–356. Mystrophora altaica Mart. Pupa:

354 – dorsal view of male pupa; 355 – anteclypeus and labrum; 356 – tarsus of midleg.

302 Anal legs massive, directed obliquely downward, broadly connected with the body of the segment (Figure 352); dorsolateral sclerite wide, chestnut brown, without dots, with a black basal margin and 4 thick, long, dark brown distal setae. Sclerite "c" large; its distal part covers the ventral side of the anal legs and partly also their outer side and almost their whole median side; sclerite with 2 setae; it bears numerous minute spinules like the adjacent membrane.

Claw with large dorsal hook and 3 pointed ventral spinules (Figure 353); transverse membranous stripe narrow and curved. Dorsal seta 1 long; curved and brown; seta 2 also long, situated subdorsally; outer surface seta 6 long and strong, dark brown; ventral setae 7 and 8 of almost the same size; seta 14 thin and smaller.

305 The larvae live in cases built of large sand grains or small stones (Figure 97); the particles are larger in the upper, convex, rooflike part of the case than in the flat ventral wall; anterior and posterior openings of the case of the same size; the mineral particles of the upper rooflike part of the case (as in pupal cases of Rhyacophilidae) are connected by strands of threads and have free spaces between them.

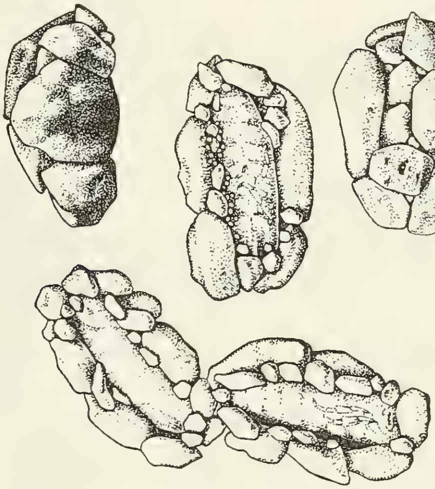


FIGURE 357. Mystrophora altaica Mart. Pupa in the cocoon and case, dorsal, ventral and lateral

**Pupa.** Length 6.5–7.0 mm (Figure 354); antennae of male reaching the 5th abdominal segment, those of the female the 7th segment; first antennal segment with 3 short setae. Clypeus with 3 setae laterally; labrum with 6 setae (Figure 355), 3 of them situated near the anterior margin, a short, median seta and 2 longer setae; 2 are situated near the lateral margin and one on the surface; the setae are projecting and dark. Mandibles with two teeth; one tooth large and serrate like the whole distal part of the blade, the second is basal and small; outer setae of mandible short, straight, situated close together; dorsal seta slightly larger and thicker than the ventral seta.

Wing sheaths of the male reaching the 4th abdominal segment, those of the female the 5th abdominal segment. The natatorial setae on segments 1–4 of the midtarsi are dense, light, longer in the dorsal row than in the ventral row (Figure 356). The spinose presegmental plates of the holding apparatus are present on segments 3–7, postsegmental plates on segments 4–5; segment 8 is small, much smaller than 7; segment 9 narrow, curved ventrally; segment 8 with wart-shaped tubercles near the posterior angles; they are also covered with spinules. Ninth segment of male pupae with a ventral process which contains the long ventral appendages of the male. End of abdomen of male pupa with 3 blackish short setae laterally; the end of the abdomen of the female pupa and of the male narrow, curved ventrally, with 3 long dark strong setae posteriorly. Cocoon opaque, thick, dark brown.

The pupal case resembles the case of the oldest larval stage; however, as in all species of Glossosomatidae, it has no ventral wall; the case is attached to the substrate by strands of strong threads (Figure 357).

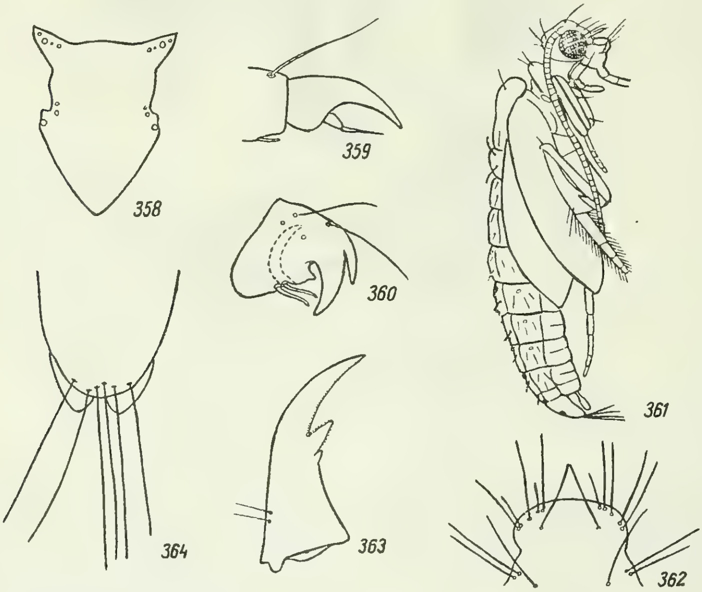
Mode of life and habitats. Brooks and rivulets with cool water and stony bottom.

Distribution. USSR: Altai, the Sayans, Maritime Territory.

### 2. **Mystrophora intermedia** Klapálek

Kimmins, 1943:96–98, Figures 1–12.

(306)



FIGURES 358–364. Mystrophora intermedia Klap. (after Kimmins):

358 – frontoclypeus; 359 – end of tarsus and claw of hind leg; 360 – claw of anal leg (only part of the setae are shown); 361 – pupa of male, lateral; 362 – labrum of pupa; 363 – right mandible of pupa, ventral; 364 – end of body of female pupa.

**Full-grown larva.** According to Kimmins (1943:96) the lateral notches of the frontoclypeus have small denticles (Figure 358); mandibles relatively short, broad at the base. Claw of legs with a blunt basal process and with a light, apical seta (Figure 359). In Kimmins' drawing, the claw of the anal legs has only one spinule, unlike the 3 ventral spinules in M. altaica (Figure 360).

Larval case built of coarse sand grains and small stones.

**Pupa.** The general habitus of the male pupa is given in Figure 361, the end of the body of the female pupa in Figure 364. Labrum and mandibles of the pupa (Figures 362, 363) resemble those of Mystrophora altaica; the number of sclerites of the holding apparatus are the same. Wing sheaths of male reaching end of abdominal segment 4. Pupal cocoon reddish brown; case built of sand grains and small stones.

Mode of life and habitats. Brooks.

Distribution. Northern part of the European USSR, Kamchatka. In addition, northern and Central Europe.

## 306 2. Genus **Glossosoma** Curtis

**Full-grown larva.** Length 8–9 mm. Sclerites brown or yellowish brown; dots on sclerites usually more or less distinct, distinct in preparations or in light forms. Periocular area wide and light. Frontoclypeus large and broad; posterior part larger than anterior part, anterior angles projecting; mandibles slightly elongate, without teeth.

Mode of life and habitats. Rapid brooks and rivulets with cool water; on stones.

Distribution. USSR: north, northwest and west of the European USSR, Caucasus, mountainous parts of Middle Asia. In addition, Europe, Asia, North and Central America.

### Key to Species

Full-grown larva

1 (2). Sclerites dark brown, with indistinct dashes and dots; Caucasus . . . . . . . . . . . . . . . . . . . . . 1. **Glossosoma unguiculatum** Mart.* (p. 333)
2 (1). Sclerites yellowish brown; dashes and dots on sclerites more distinct; north of the European USSR . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Glossosoma vernale** Pict. (p. 335)

### 1. **Glossosoma unguiculatum** Martynov, larva nova

**Full-grown larva.** Length 6.5–7.2 mm. Head chestnut brown dorsally, lighter ventrally and near the occipital foramen, with distinct dots; eyes situated on a large light yellow area with a posterior and lateral light

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* The identification should be checked by examination of a full-grown pupa to avoid confusion with the closely related species Glossosoma capitatum Mart.

307 process; gula light brown. Anterior-margin setae slightly coarser than in Mystrophora altaica; lateral seta straight and light; intermediate seta black, strong, one of the longest setae of the head; median seta straight, short and dark. Anterior frontal seta situated near the curvature of the frontal suture, short and light; middle seta situated nearby, slightly longer, dark; posterior frontal seta strong, black, slightly longer than anterior-margin seta. Seta 9 also black, large, situated near the middle of the anterior branch of the frontal suture; seta 11 situated posterior to it, short and thin; seta 7 dark, moderately long, situated posteriorly, markedly medially to the antenna; seta 8 blunt, short and light; posteriorly, the dark and strong seta is situated laterally on a light area near the eye; unlike in Agapetus, it is longer than seta 14; seta 14 situated more medially, on the boundary of the light periocular area, is short and brownish; the small, light, inward-curved seta 13 situated laterally near the margin of the area. Ventral seta 18 small, thick and divided.

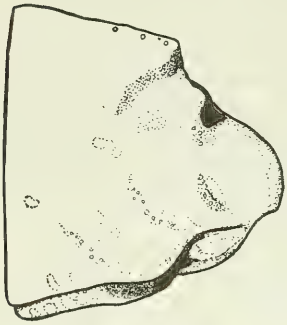


FIGURE 365. Glossosoma unguiculatum Mart. Pronotum

Labrum with a sharply defined dark, almost black, dorsal sclerite; setae 2 and 4 situated on a membrane, light and brownish; setae 3 and 5 situated at the sides of the sclerite; they are strong, black and longer, like the surface seta 6.

Mandibles slightly longer and narrower than in Mystrophora; a dense tuft of short simple chetoids on a common base situated in the median depression of the left mandible; 12 soft, light-feathered chetoids arranged in pairs situated further basally; 13 feathered chetoids in the median depression of the right mandible.

Cardo with a short light seta; submentum grayish, with a broad anterior margin and narrow, concave posterior margin; setae light brown, short near the anterior margin; stipes grayish brown and divided, with a reddish brown median ridge; mediodistal seta small and light; outer basal seta short and light brown.

Pronotum (Figure 365) with light yellowish anterior margin; a similar light spot posterior to the dark anterior-angle process; posterior part of sclerite with two large light dots near the median suture and a group of dashes and dots in the middle of each half. Setae as in Mystrophora altaica but darker and stronger.

Dorsal sclerite of segment 9 chestnut brown; medioanal anterior-angle and lateral are situated close together near the posterior margin, strong, long and black; a short light intermediate seta near the medioanal seta.

Dorsolateral sclerite of anal legs chestnut brown, with large, yellowish, indistinct dots; a light, transverse, subapical stripe with 2 long black disto-dorsal setae; outer setae lateral to the distal ligulate process of the sclerite also strong, black and shorter than the dorsal setae. Both setae of the wide sclerite "c," spines on this sclerite and distal margin of sclerite "b" light. Claw with a narrow, transverse, membranous stripe with a large dorsal denticle; seta 1 short, seta 2 longer; basomedial seta 4 small; ventral seta 8 light and curved; seta 7 dark and thinner.

Mode of life and habitats. Cold-water rivulets with stony bottom.

Distribution. USSR: Caucasus.

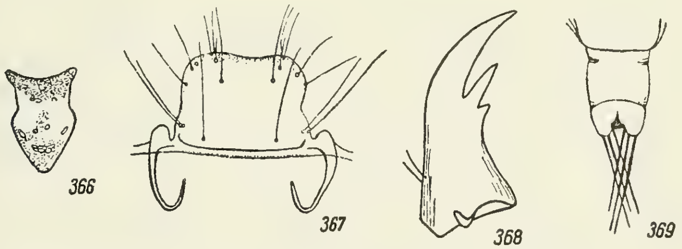
### 2. Glossosoma vernale Pictet

Pictet, 1834:190, Plate XV, Figure 4, a, c. — Hagen, 1864:143. — Siltala, 1905:152—153, Figure 40. — Ulmer, 1909:222, 290. — Lestage, 1921:423—426, Figure 135, g.

**Full-grown larva.** Length 8—9 mm. Head yellowish brown. Frontoclypeus (Figure 366) darker anteriorly than posteriorly; its posterior part with distinct light dots; light, darkly rimmed dots lateral to the coronal suture and at the beginning of the frontal sutures.

Median brush of mandibles as in G. unguiculatum; left mandible with a brush of simple chetoids and several long feathered chetoids; right mandible with only feathered chetoids.

308 Pronotum yellowish brown, with indistinct dots. Legs without dots.



FIGURES 366—369. Glossosoma vernale Pict. (after Siltala):

366 — frontoclypeus; 367 — labrum and anteclypeus of pupa; 368 — left mandible of pupa, dorsal; 369 — end of body of male pupa.

**Pupa.** Length about 7 mm. Antennae of female pupa reaching to the anterior margin of abdominal segment 6. Three setae on each side of the clypeus; setae almost equally long; anterior margin of labrum with a shallow median notch; labrum with 6 setae, anterior median seta much smaller than the others (Figure 367). Mandibles (Figure 368) as in other species of Glossosomatinae, serrate in the middle; basal tooth small; outer setae small, situated close together, equally long.

Number of spinules of holding apparatus: III:14—16; IV:17—22+ 33—44; V:16—26+ 31—42; VI:12—20; VII:14—40; the sides of segments 8 and 9 with tubercles covered with spinules near the posterior margin.

Posterior end of body narrow, curved ventrally in males (Figure 369) and in females; lobes each with 3 setae.

Pupal case 8—12 mm long and 6—8 mm broad, built of small stones; cocoon yellowish brown.

Mode of life and habitats. Brooks and rivulets with cool water, on stones.

Distribution. USSR: west of the European part. In addition, southern, Central and northern Europe.

## 2. Subfamily AGAPETINAE Martynov

**Full-grown larva.** Length 4.5–6.2 mm. Head short and broad. Frontoclypeus large, with rounded lateral notches in the anterior third; gula fused with pregula outside the head capsule. Antennae, as in Glossosomatinae, situated anterior to the eyes, with 2 sensillae and 2 setae, median seta longer than outer seta.

Mandibles with a distinct transverse groove, spatulate, without teeth; median chetoids on left mandible simple and feathered; those of right mandible feathered and fewer in number than in the Glossosomatinae; outer setae at base of mandible situated close together; ventroposterior seta small and thin; dorsal seta long and dark. Submentum divided.

Prothorax with convex dorsal surface and short ventral surface; therefore, mouth of the larva directed obliquely downward, as in Glossosomatinae. Secondary setae of pronotum numerous, unlike in Glossosomatinae. Tergites present on meso- and metathorax. Pleural sclerites and prosternum as in Glossosomatinae; mesosternum not divided. Legs thin and narrow, little differentiated; basal spinule of claw small, situated basal to the seta.

Abdomen, dorsal sclerite of segment 9, and anal legs as in Glossosomatinae. Claw small, strong, with a small dorsal claw and 7 setae; seta 5 absent.

The larvae live in cases with a flat ventral side and a convex dorsal side; anterior and posterior ends of case similar; the ends of the case are elongated in form of tubes before the openings.

**Pupa.** Length 3–5 mm. Antennae reaching end of abdominal segment 5; first antennal segment with 1 seta. Labrum with straight anterior margin
309 and rounded lateral margins; median seta small. Mandibles symmetrical, serrate in the middle; basal seta small. Wing sheaths pointed; natatorial setae present on 1st to 4th tarsal segments of the midlegs. Cocoon transparent; case shieldlike, 4–8 mm long.

Mode of life and habitats. Springs, brooks, rivulets and rivers with cool water.

Distribution. USSR: European and Asian parts, mainly in mountain regions, e. g., Crimea, Caucasus, mountains of Middle Asia, Altai, the Sayans, Far East. In addition, Europe, Asia, partly Africa, North and Central America, Australia (isolated species).

## 3. Genus **Agapetus** Curtis

The only genus of the subfamily in the USSR for which the development is known.*

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* The second genus Eoagapetus Mart. is represented in the USSR only by E. praeteritus Mart., larvae and pupae of which are unknown.

Key to Species

Full-grown larva

1 (2). Length 6.0–6.2 mm. Pronotum dark brown, with more or less distinct dots laterally; tergites of meso- and metanotum dark brown, with light dots, clearly differentiated; walls of larval case thick, built of coarse sand grains . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Agapetus fuscipes** Curt. (p. 337)

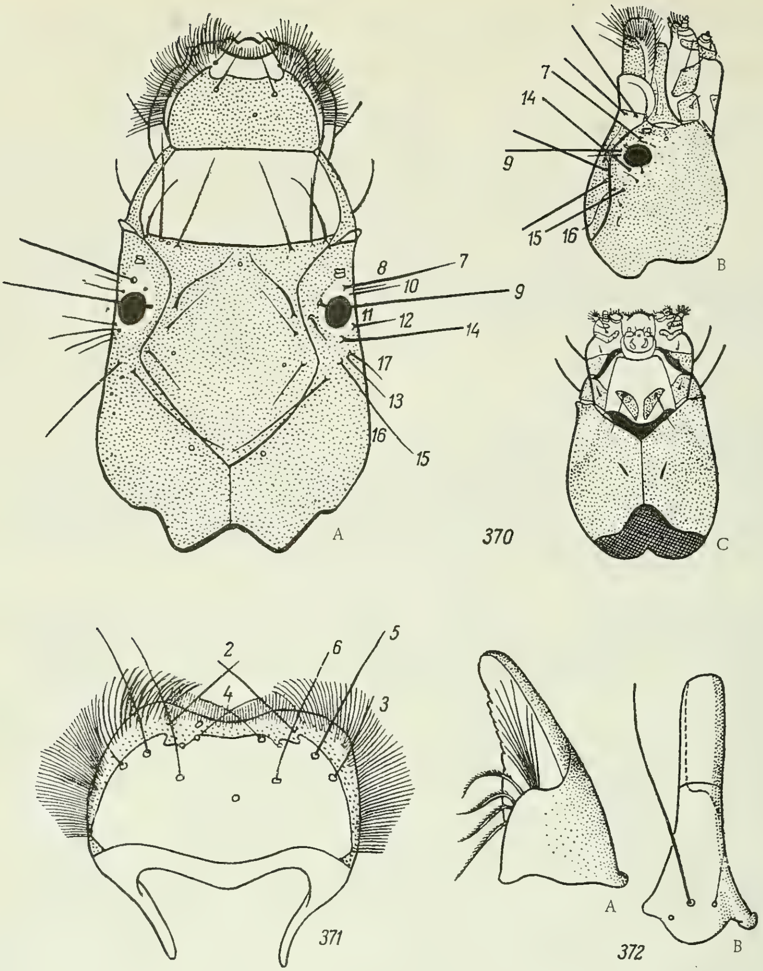
2 (1). Length 5.0–5.5 mm. Pronotum without dots; tergites of meso- and metathorax thin and yellowish brown; walls of larval case not thick, sometimes loose, built of sand grains and small stones . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Agapetus comatus** Pict. (p. 344)

## 1. **Agapetus fuscipes** Curtis

Klapálek, 1893:131–134, Figure 36. – Struck, 1900:28, Figures 44–45. – Ulmer, 1903:130; 1909:222, 290. – Siltala, 1905:157–158. – Lestage, 1921: 426–429, Figure 136, d. – Nielsen, 1937:253–263; 1942:358–374, Figures 23–35. – Hickin, 1943:78–80, Figures 1–9.

**Full-grown larva** (7th stage). Length at the end of the stage 6.25 mm, width of head 0.48 mm; ratio of length of head, thorax and abdomen 10:34:87; larvae massive, width about 0.22 of length; greatest breadth in the region of abdominal segment 4. Head (Figure 370) dark brown; length, greatest width and height of head almost the same; mouthparts long as in other species of Agapetus; eyes situated in anterior third of head, on a wide, irregularly pear-shaped light area; antennae situated outside the light area anterior to the eyes. Gular suture without bifurcation; gula fused with pregula outside head capsule. Anterior angles of the wide frontoclypeus slightly projecting beyond anterior margin of head; medio-anal and intermediate setae of the 3 anterior-margin setae straight, relatively long; lateral seta and anterior frontal seta curved and recumbent; all 3 frontal setae situated close together, behind each other, behind the lateral curvature; middle and posterior frontal setae projecting and relatively long. Setae 7, 9, 14 and 15 dark, are among the longest setae of the head; other dorsal setae small and light; setae 9 and 11 displaced posteriorly to about the level of the middle of the eye; long seta 7 and short seta 8 situated close to seta 10; seta 7 situated anteriorly and slightly dorsally, seta 8 situated ventral to seta 7; setae 14 and 12 situated immediately posterior to the eye on a light background; setae 15 and 16 situated on a dark background; seta 16 curved in the medioanal direction, curved to the sclerite; ends of the setae meeting near the bifurcation of the frontal sutures; ventral seta 18 retaining its original position, is short, light, feathered and situated in about the middle of the head.

Anteclypeus wide and light. Dorsal sclerite of labrum (Figure 371) brown, with a median process and lateral notches at the sides of the anterior margin; light seta 1 concealed among the hairs; setae 4 situated on the angles of the median process, light and long; other setae dark; seta 2 situated on a membrane; setae 5 and 6 long; seta 3 shorter, situated at the margin; the median pit slightly displaced to the right.



FIGURES 370–372. Agapetus fuscipes Curt. (after Nielsen):

370 – head, dorsal (A), lateral (B) and ventral (C); 371 – labrum; 372 – left mandible, ventral (A); outer view of right mandible (B).

Mandibles (Figure 372) dark brown in the basal part, reddish yellow in 310 the apical part; left mandible with rounded apex; upper blade with denticles; 4 soft feathered chetoids at the base, near the margin of the median depression; anterior to them a tuft of 10–12 straight, stiff chetoids; right mandible with straight distal margin, with 7 basal feathered chetoids; outer setae situated near the base of the mandible; a small thin seta situated nearby more ventrally; further dorsally, a thick, long seta, which almost reaches the end of the mandible.

Maxillolabium wide (Figure 370, C); submentum with 2 oblique, oblong sclerites in the basal part; a short, thin seta near the anterior margin of the sclerites; seta of cardo very small; stipes with broad, black, median margin; basal seta relatively long; distal seta very small; palpiger horseshoe-shaped; its distal seta situated on a membrane and relatively long;
311 mediobasal seta small. Maxillary palp short and thick; first palp segment reduced in the middle, its sclerite open; sclerites of the 3 other segments ring-shaped; 2nd segment longer than the following segments. Galea in form of a small tubercle covered with hairs; a crescent-shaped sclerite at its base; sensillae short, concealed among the hairs; setae also little marked, except two. Mentum short, strongly curved, dark brown; ventral sclerites small, with a light distal seta; labial palpiger curved; labial palps and labial lobe very small; a broad, membranous process further dorsally, which is trifid and covered with minute, thin, light spinules.

Pronotum (Figure 373) dark brown, convex; its anterior margin projecting; posterior margin with a broad, median notch; a row of lighter, large dots near the lateral margin; posterior angles rounded and projecting. Anterior-angle and anterior-margin setae forming fans near the anterior angles; their number is 28—32; primary setae not recognizable among the secondary setae; a transverse row of 10 setae in the posterior half of the sclerite, 3 primary setae distinguishable by their length; two lateral groups of setae laterally, near the margin of the sclerite: an anterior group of 4 setae and a posterior group of 2 setae; one group situated near the margin and the second closer to the transverse row.

Meso- and metanotum chestnut brown, small, with light dots (Figure 373); setae relatively long, resembling those of pronotum; anterior-margin seta situated between the tergites; anterior-angle setae situated together with the small secondary setae lateral to them; long medioanal setae situated together with the small, thin, intermediate and lateral seta, posterior to the tergites.

Episternum and trochantin of pleuron of the prothorax fused; seta of trochantin small, situated near two setules; epimeron of prothorax without seta, which is displaced to the dorsal sclerite. Pleural sclerites of meso- and metathorax large; epimeron larger than episternum, which is fused with the trochantin (Figure 373, B); a long seta situated near the lateral margin of each of the two parts of the pleuron.

Prothorax ventrally almost completely covered by a small brown sternite (Figure 373, B) with a broad anterior sclerite and a narrow, posterior sclerite; posterior sclerite with prolonged posterior angles which are almost contiguous with the angles of the dorsal sclerite.

Mesosternum represented by a short, broad sclerite at the posterior margin of the segment; metathorax completely membranous ventrally.

Legs of almost the same length; forelegs slightly longer than midlegs and hind legs; length ratio of legs 101:100:98; midlegs about 0.3 as long as the larva. Midlegs (Figure 375) and especially hind legs thicker than forelegs; coxae relatively long, longer than the femora; tarsi short.

Coxae with a deep dorsodistal notch. Basodorsal anterior seta of coxa of forelegs short, thin and yellow; slightly longer on the midlegs and hind legs; distodorsal anterior seta of coxa of forelegs shorter than posterior seta, of the same length on midlegs and hind legs; both these long setae situated in about the middle of the segment; both anterior surface setae of the coxa of all legs are small; posterior ventrodistal seta much longer than anterior seta; this seta is 2.5 times longer than the anterior seta on the midlegs.

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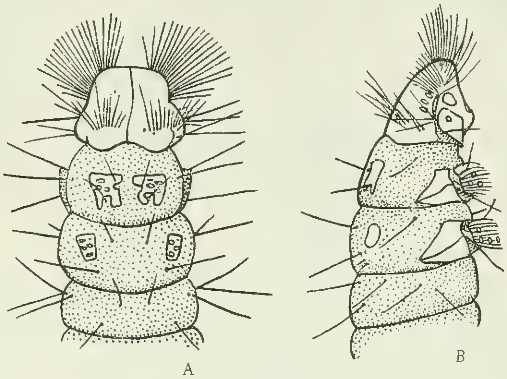

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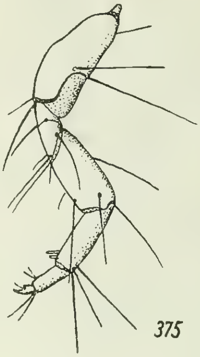

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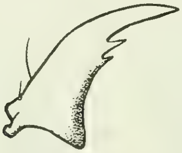

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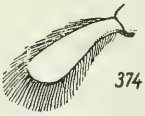

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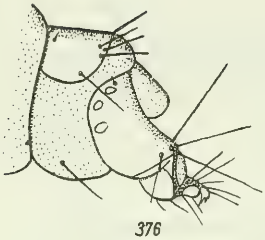

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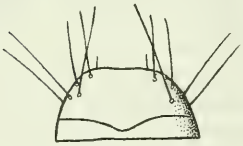

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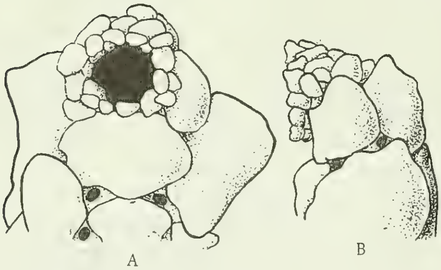

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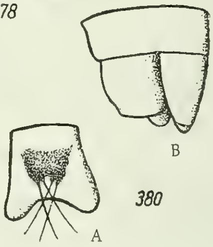

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FIGURES 373–380. Agapetus fuscipes Curt. (after Nielsen):

373 – thorax and abdominal segment 1, dorsal (A) and lateral (B); 374 – posterior distoventral seta of the fore tibia; 375 – right midleg, posterior; 376 – abdominal segment 9 and the anal legs, lateral; 377 – anterior end of larval case, ventral (A) and lateral (B); 378 – labrum of pupa; 379 – right mandible of pupa, ventral; 380 – end of body of male pupa, dorsal (A) and lateral (B).

Both sclerites of trochanter open dorsally, their ends pointed; anterior surface seta of forelegs represented by a coarse feathered spine; represented on midlegs and hind legs by a black spinelike seta; posterior surface seta of trochanter of all legs long; both posterior setae of the 5 ventral setae long and situated subapically; 3 anterior setae small and thin; basal seta situated near the suture and slightly larger than the other.

Both dorsal setae of femora long; anterior surface seta of femur of forelegs short and dark, spinelike, that of midlegs and hind legs, long, like the posterior surface seta; ventrodistal seta long; ventrobasal seta situated in the middle of the segment, thin, spinelike and slightly curved.

Anterior seta of the tibiae displaced toward the dorsal seta, forming a group of 3 long, black distodorsal setae; posterior seta and ventral setae forming a group of 3 small, distoventral setae covered with spinules; the setae at the sides are spatulate (Figure 374) and their margin is fringed with hairs.

Dorsodistal setae of tarsi dark, longer than the small, light, distoventral setae, with small pointed spinules at the base of the setae.

Claw strong, with a small process at the base of the basal seta; basal part of claw darker than distal part.

Anterior-angle, anterior-margin and medioanal setae of dorsum of abdominal segments 1–8 relatively large; secondary anterior-angle setae, intermediate and lateral seta small. Both setae of the pleura of abdominal
313 segment 1 long; only the posterior seta is long on segments 2 and 3; anterior lateral seta of segments 2 and 3 and both setae of segments 4–7 small and pale; outer, lateral seta of segment 8 displaced to the dorsal side and situated near the row of setae formed by the anterior-angle seta and the 3 dorsal surface setae. Middle and lateroventral seta on the 1st and 2nd segments longer than the others which are thin and small; the intermediate seta is the longest on segments 7–8.

Dorsal sclerite of segment 9 dark brown, trapezoidal, almost completely covering the dorsum (Figure 376); anterior-margin setae small and setuliform; 5 setae on each side near the posterior margin, 3 posterior surface setae, an anterior-angle seta and a lateroventral seta, which is situated at the margin; except for the short and thin intermediate seta, setae at posterior margin dark, blackish brown and long. Anus with 2 lateral folds; 6 anal gills.

Anal legs short and thick, directed obliquely ventrally. Sclerite "b" dark brown, large, covering the dorsal and lateral sides of the anal leg and part of the ventral side; large spots laterally, near the anterior margin; the claw articulates with a black sclerite at the distal margin; 4 dorsodistal setae of sclerite "b" black, relatively long, forming a fan. The wide, convex sclerite "c" extends ventromedially and bears 2 thin pale setae.

Claw with a wide base and its tip bent at a right angle with 4 small dorsal denticles; denticles and the apical part of the claw yellowish brown. In addition to setae 1, 2 and 3, setae 4 and 6 are displaced to the dorsal side of the claw; seta 5 absent;* seta 8 situated on the membrane of the transverse stripe; transparent, shorter and thicker than the others; seta 7 long.

Case of full-grown larva (Figure 377) built of fine and coarse sand grains; it consists of a rooflike convex upper side and a flat, lower side; openings at the anterior and posterior end of the case are similar, in form of short downward-directed tubes which are made of very small sand grains; the small stones of the case are connected with numerous small ventilation holes.

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* Nielsen (1942:369) states that this seta is displaced to sclerite "c."

The cases of Agapetus are spacious; the larva can freely turn in them from side to side, sticking its head out either of the anterior or posterior end. Case of full-grown larva 8 mm long.

**Young larva.** There are seven larval stages. The length of the body and the width of the head of the larvae in the different stages are given in Table 2 (after Nielsen).

TABLE 2

| Stage | Length (mm) | Width of head (mm) |
|---|---|---|
| 1st ................ | 0.8–1.2 | 0.13 |
| 2nd ................ | 1.2–1.64 | 0.15 |
| 3rd ................ | 1.31–2.19 | 0.17 |
| 4th ................ | 1.75–2.32 | 0.21 |
| 5th ................ | 2.18–3.42 | 0.27 |
| 6th ................ | 2.52–4.30 | 0.35 |
| 7th ................ | 3.76–6.25 | 0.43–0.48 |

The larvae of the 1st stage (Figure 381) is slender, as in the species of Rhyacophila; the broad abdomen characteristic for the older stages is absent; setae relatively long; form and setae of head, mandibles, foreleg, abdominal segment 9 and anal legs shown in Figures 382–385.

The body of the larva of the 2nd stage and its primary setae remain slender; sclerites of head, pronotum, segment 9 and anal legs become brownish. The sclerites become slightly darker in the 3rd stage. The form of the larva in the 4th, 5th and 6th stages becomes gradually similar to the form characteristic for the full-grown larva, and the sclerites become chestnut brown; setae of head and anal legs are still moderately long in the 4th and 5th stage.

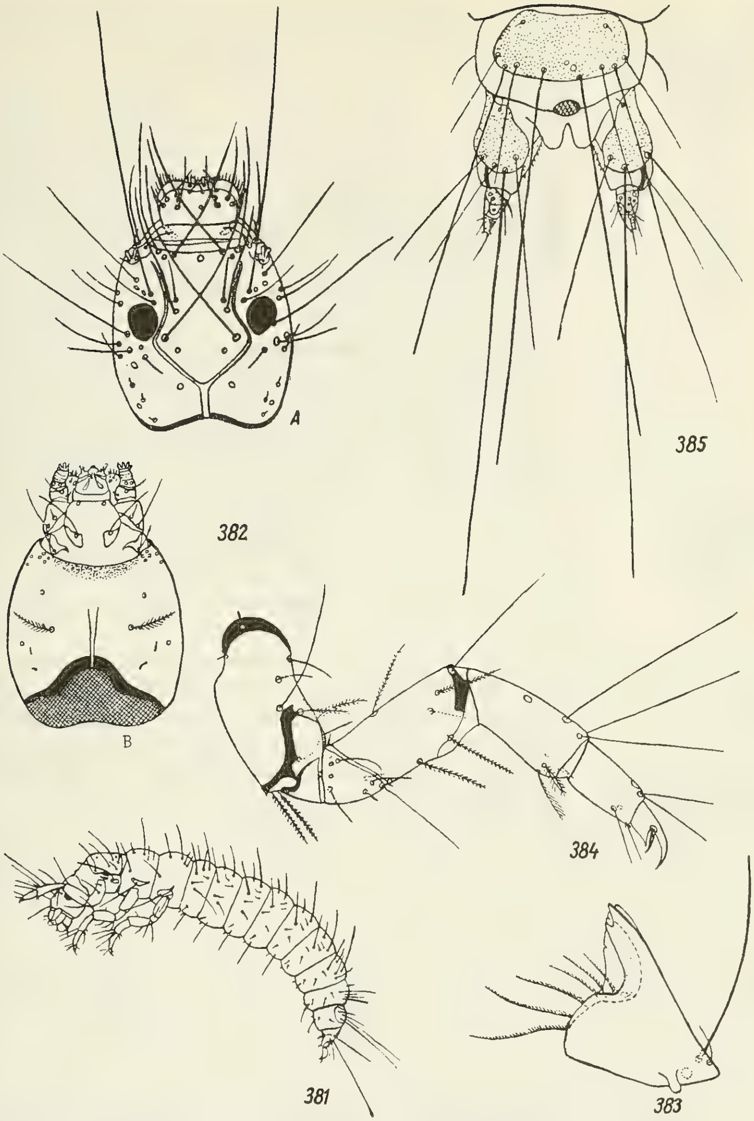
The increase of the number of secondary setae of the thorax is given in Table 3 (after Nielsen).

TABLE 3

(315)

| Setae | Stage | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th |
| Anterior-angle and anterior-margin setae.. | 1 | 6–10 | 12–17 | 17–24 | 24–26 | 26–31 | 28–32 |
| Surface setae ......... | 4 | 4 | 7–8 | 10–12 | 12–14 | 13–17 | 16–17 |
| Lateral setae (in the middle of the lateral margin) ............ | 0 | 0 | 1 | 2 | 2–3 | 3–4 | 4–5 |

A small, secondary seta appears near the primary anterior-angle seta of meso- and metathorax from the 3rd stage onward.



FIGURES 381–385. Agapetus fuscipes Curt., young larva (after Nielsen):

381 – 1st-stage larva, lateral; 382 – head, dorsal (A), ventral (B); 383 – left mandible, ventral; 384 – foreleg, posterior; 385 – abdominal segment 9 and anal legs, dorsal.

Each side of the posterior margin of the sclerite of segment 9 bears 4 setae in the 1st and 2nd stage; lateroventral seta situated at the sides of the segment; it is displaced to the posterior angle of the sclerite only from the 3rd stage onward. Claw of the 1st-, 2nd- and 3rd-stage larvae with two dorsal denticles; two additional denticles appear above them in the 4th or 5th stage.

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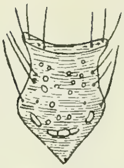

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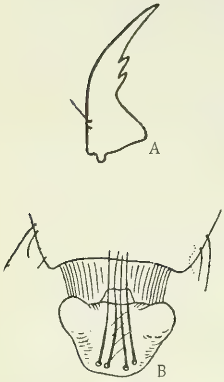

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FIGURES 386 and 387. Agapetus comatus Pict. (after Siltala):

386 – larva: frontoclypeus; 387 – pupa: right mandible, ventral (A), end of body of male pupa (B).

From the 1st stage onward, the larvae live in a case, building a new case after each molt. Length of case of 1st-stage larva 1.8 mm.

**Pupa.** Length 3.2–4.0 mm. Antennae reaching the 5th abdominal segment; 1st antennal segment with one seta. Labrum (Figure 378) broad, with a straight, anterior margin and with rounded sides; anterior seta thick, short, light; the other 5 setae long and strong; posterior half of labrum covered with small tubercles. Mandibles (Figure 379) symmetrical; each mandible with 2 pointed, distally directed teeth in the middle; mandibles grayish brown at the base, yellow apically; distal part of mandible and teeth finely serrated; outer setae small; basal seta shorter than distal seta.

The wing sheaths reach the 6th abdominal segment. Natatorial setae present on segments 1–4 of mid-tarsi, longer in the dorsal row than in the ventral row; distomedian process of pretarsus reaching to half the claw. Presegmental plates small and rounded on segments 4–7; postsegmental plates transversely oblong, larger on segment 4; number of spinules as follows: IV:20+65, V:25, VI:25, VII:20. The end of the body of the male pupa is shown in Figure 380.

Pupal case, as in all Glossomatidae, without lower wall and attached to a stone by strands of tissue. Pupal case 7–8 mm long as in the full-grown larva.

Mode of life and habitats. Brooks and springs with cool water.

Distribution. USSR: in the western boundary area of the European part. In addition, Europe.

## 2. Agapetus comatus Pictet

Klapálek, 1888:59–61, Figure 21. – Ulmer, 1903:130; 1909:222, 290, Figure 426. – Siltala, 1905:155–158, Figure 40. – Lestage, 1921:427–429, Figure 136.

**Full-grown larva.** Smaller than Ag. fuscipes; form of body similar; length 4.5–5.5 mm. Head yellowish brown, with dark posterior margin; pattern indistinct. Frontoclypeus with a curved row of coarse dots at the posterior margin;* dots in anterior part small; several indistinct dots also lateral to the coronal suture and on the ventral side.

Labrum and mandibles as in A. fuscipes.

Pronotum yellowish brown, without pattern. Tergites of meso- and metathorax small, indistinct, especially on the metathorax. Sclerites of pleura as in A. fuscipes; pleuron of prothorax with a short seta and 2 setules in a row in the region of the trochantin. Legs brownish and
316 without pattern; distoventral setae of tibiae situated together with the posterodistal seta (Figure 387); as in A. fuscipes, they form a group,

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* Visible in preparations.

which consists of a small median spine (posterior, distoventral seta) and 2 small spatulate setae at the sides.

Sclerite of abdominal segment 9 and anal legs as in A. fuscipes; claw with 1 dorsal denticle.

Larval case built of loosely connected sand grains, not as solid and thick as in A. fuscipes.

**Pupa.** Length of male pupa 3.5–4.7 mm; length of female pupa 5.0–5.4 mm. Antennae reaching abdominal segments 4–5; wing sheaths reaching segments 5–7. Labrum and mandibles as in A. fuscipes. Number of denticles on the plates of the holding apparatus as follows: IV:7–20+40–80; V:14–35; VI:10–30; VII:8–20. End of body of male pupa shown in Figure 387, B.

Pupal case 4.5–6.5 mm long; stones on the dorsal side may be 3.5–2.8 mm. Cocoon brown, 3.5–5.0 mm long.

Mode of life and habitats. Brooks and larger streams with cool water.

Distribution. Northwest and west of the European USSR, Caucasus. In addition, Europe.

## III. Family HYDROPTILIDAE Stephens

**Full-grown larva.** Small, 2.5–5.5 mm long; head and thorax of about the same width; middle segments of abdomen much broader and higher than thorax. Head prognathous; dorsal surface of head convex; height of head increasing from the anterior margin to the middle or to the posterior third; anteclypeus and labrum directed not forward as in Rhyacophilidae, but slightly downward as in Glossomatinae and Agapetinae. The striking character of the family is the fusion of the head sclerites in some genera, in which the sutures are indistinct (Agraylea) or absent altogether, so that the epicranium forms a complete capsule (Hydroptila). Gula triangular or undifferentiated, fused with the head capsule. Antennae situated near the upper articulation of the mandible as in Integripalpia (see Nielsen, 1942:272; 1948:20–22), with a slender sensilla, which is sclerotized completely, except for the soft, thin-walled tip; a light seta at the base of the sensilla in the middle or in distal part; this seta is several times as long as the rod in some genera. Eyes relatively large, situated at midlength of the head or in its anterior third. Setae of head well developed; the longest (9, 12, 14, 17) are twice, three times, and sometimes almost four times as long as the width of the head; ventral seta 18 sometimes absent (Oxyethira).

Labrum with broad, membranous, anterior margin, sometimes asymmetrical; seta 3 slightly curved inward; setae 5 and 6 longer than the others, often much longer than the labrum. Mandibles asymmetrical; left mandible with a deep, median depression, with teeth and processes on the upper blade (sometimes also on the lower blade) and with a brush of chetoids in the median notch; right mandible with a hardly marked median depression or a depression absent, with one blade without teeth or with small teeth; inner margin of right mandible with a small, membranous part in some species of Agraylea and Hydroptila; this margin overhangs the sclerotized part of the mandible near it; ventral of 2 outer setae of mandibles curved, situated slightly basal or distal to the dorsal seta.

Pregula forming a transverse sclerite, which is sometimes interrupted in the middle; pregula divided in this case (Orthotrichia). Submentum varying in form, with straight or slightly concave anterior margin; posterior margin curved or with a median process; setae at the sides short or moderately long. Stipes with two sclerites, a small lateral sclerite and a larger ventral sclerite; apical seta shorter or almost as long as the basal seta. Palpiger with a wide lateroventral sclerite; distal seta long and strong; median seta small and thin. First segment of maxillary palp incompletely sclerotized and fused with the galea; segments 2 and 3 with ring-shaped sclerites, sometimes fused; last segment with membranous apex; number of sensillae 3 or 4. Galea partly sclerotized on the inner side and ventrally at the base, with characteristic sensillae and setae. Setae 3 and 6 of galea situated ventrally; setae 4, 5, 7, 8 and 9 situated dorsally; last 4 setae forming a longitudinal row; lateral sensilla of the galea of group I is inflated apically; it is always present, sometimes very long
317 (Orthotrichia); median sensilla present only in Oxyethira; 2 ventrodistal sensillae of group II setuliform; the distal of the 2 sensillae of group III are situated in the middle, the apical sensilla is two-segmented; the basal sensilla is sometimes club-shaped (Figure 394).

Mentum forming a curved, transverse sclerite with a deep notch at the anterior margin; posterior margin of sclerite covered by the membranous fold of the submentum; Small, ventral sclerites rounded or slightly oblong, with a very short seta; labial palpifer relatively large, sickle-shaped, with anteriorly extending mediodistal ends. Labium short, slightly laterally compressed, sometimes flattened in the basal part (Ithytrichia); the one-segmented labial palp with two terminal sensillae.

The thoracic segments differ little in size; metathorax usually broader than the other segments. Nota of all 3 segments sclerotized; pronotum in the 5th-stage larva completely covering the segment anteriorly, but the anterior margin of meso- and metathorax remain membranous (as in the young larvae). Pronotum always extending farther laterally than the sclerites of meso- and metathorax and sometimes more strongly curved, resembling part of a circle or ellipse in cross section. Median suture of dorsal sclerites of thorax sometimes diverging at the end, forming a small, wedge-shaped notch; this suture is sometimes (Agraylea) not as clearly marked on meso- and metanotum as on the prothorax, and may be absent in the weakly sclerotized posterior part of the metathorax. Anterior angle of pronotum rounded; its posterior margin forms a ridge or groove; angles of sclerites of meso- and metathorax usually sharply marked.

Primary anterior-margin seta of pronotum displaced posteriorly toward the middle setae, forming a transverse row of 4 setae arranged in pairs (setae 1 and 2, 3 and 4); in some genera, seta 5 stands near the former group and seta 6 near the latter group. Near the anterior margin of the pronotum are 3 series of secondary setae which develop from the 2nd stage onward: 1) 3 long and thick setae of group M; 2) groups of short, thin, anteriorly curved yellow setae (m); 3) very small setae situated between the groups M and m. In the anterior angles of the sclerite, near the long, primary seta (A), there are 1 or 2 thin, secondary setae (a); the secondary setae L and l are situated in the middle of the lateral margin; seta l is thinner and shorter than seta L (Figure 395, A, B). The primary anterior-margin seta of the meso- and metanotum retains its position near the anterior margin; shorter, yellow, curved, secondary setae are situated near it; 2–4 secondary setae are situated near the anterior angle (near the primary seta); a transverse row of 3 primary surface setae, the middle of which is larger than the others, in the middle of the sclerite or slightly more anally.

Episternum of prothorax complete; epimeron divided; trochantin oblong (except in Oxyethira), hornlike, with a small distal seta and 2 setules; episternum of meso- and metathorax divided, its anterior part fused with the trochantin and with a short seta (Figures 395, 396); epimeron of all 3 thoracic segments with a small seta.

The ventral sclerotization of the thorax (unlike in the other Annulipalpia) consists of single and paired sclerites, which are present on all or only some of the thoracic segments; presegmentally, the ventral surface bears 3 small setules on each side.

Legs of full-grown larvae of Hydroptilidae (with rare exceptions, e. g., Leiochiton) moderately long or shorter. The forelegs are specialized, in connection with the building activity of the larva, and always shorter than the other legs; hind legs slightly longer than midlegs. Coxae of all legs are broader than the femora and about as long as the femora; trochanters open dorsally; femora of midlegs and hind legs moderately long; they are short on the midlegs, except in Ithytrichia, with a basal process which bears both ventral setae of the femur; fore tibiae with a long, distal process, which bears a complex system of chetae in some genera (Agraylea, Hydroptila, Oxyethira); small distal processes are present in Hydroptila on the mid- and hind tibiae; tibiae and tarsi of midlegs and hind legs long in other genera; tarsi straight, tibiae slightly curved (Figures 467 and 486). Claw long and slightly curved.

The chaetotaxy of the legs consists only of primary setae which are often strongly modified and form spines (further details in the description of genera and species). Basoventral seta of claw always straight and thin.

Middle segments of abdomen of full-grown larvae always much broader and higher than head and thorax; first two abdominal segments and the last 318 two segments smaller than the others; abdominal segment 2 of the larva of Orthotrichia and Ithytrichia with lateral processes which resemble those of abdominal segment 1 of eruciform larvae (which indicates the great age of the group); sides of abdominal segments 1 and 2 of the larvae of Agraylea and Hydroptila with folds. Segments 3–8 of the larva of Ithytrichia with specific median, dorsal and ventral sucker-shaped processes; dorsum of abdominal segments 1–8 of full-grown larvae (exception Stactobia) membranous; abdominal segment 9 always with a dorsal sclerite; unlike in most Annulipalpia, but as in Rhyacophilidae, Glossosomatidae and Integripalpia, the anus is not a transverse, but a longitudinal slit. Anterior margin of dorsum of abdominal segments 3–7 (sometimes also of segments 2 and 8) with unicellular glands characteristic for Hydroptilidae; these glands are remarkable for their large size (up to $90\mu$); similar glands are also present in Orthotrichia and Ithytrichia, on abdominal segment 1, and are arranged in a ring.

Abdominal setae of full-grown larvae of Hydroptilidae markedly reduced compared with the young larva; some of them form setules or are absent in some places. The most prominent setae on the abdomen are the anterior-angle and medioanal surface setae; anterior-angle seta of middle and posterior segments displaced posteriorly and situated close to the surface setae. Intermediate ventral seta of 1st segment always absent. Anterior-angle, dorsal seta of the 9th segment, situated, as in other families, in the posterior angle of the sclerite near the 3 surface setae at the posterior margin; medioanal seta much longer than the others; anterior-margin seta (unlike in the other Annulipalpia) clearly marked, small or moderately long, displaced to the middle of the sclerite or, displaced toward the anal setae as in Orthotrichia.

Anal legs of the 5th-stage larvae short and forming two hemispherical or broadly conical processes lateral to the large folds surrounding the anus. Sclerite "b" of basal segment has a dorsolateral position; distal part of sclerite differentiated in form of a narrow, slightly curved stripe, which forms a bridge between sclerite "b" and the claw; sclerite "b" with a laterodistal seta and 2 dorsal setae; an apical and a subapical seta; the distodorsal seta and the seta of the bridge are the longest setae of the anal legs; ventral sclerite "c" long, with a very short seta.

Claws small and short, hooklike; transverse, membranous stripe on inner side of claw broad; claw of full-grown larva directed not ventrally but laterally as in larvae of Integripalpia. Of the 8 setae of the claw (if all are present), there are setae 1 and 4 on the inner side, setae 2 and 5 on the outer side in the basal part near the transverse, membranous stripe or on it; setae 7 and 8 have a characteristic position in the basal part of the claw; setae 6 and 3 are situated dorsally on each side of the claw, in its distal part; setae 2, 3, 7 and 8 are always present; setae 1, 4, 5 and 6 may be absent in some genera (Oxyethira, Orthotrichia, Ithytrichia).

Three genera have tracheal gills, which consist of three filaments (Hydroptila, Orthotrichia) or one filament (Ithytrichia); the gills are situated dorsally on the end of abdominal segment 9 or on the anal legs, near the base of the claw.

A case is built only by the 5th-stage larvae; the larvae of the first 4 stages live without a case. The case is made of secretion (Oxyethira, Orthotrichia), of secretion and algae (Agraylea) or of secretion with a covering of minute sand grains or diatoms (Hydroptila). The form of the case differs in the various genera (see pp. 359, 370).

**Young larva.** The young larvae of Hydroptilidae have a broad head and a short, narrow abdomen, which tapers gradually posteriorly. Setae which are sometimes longer than the abdomen are present on the head, end of the body and sometimes (Agraylea) also on some other abdominal segments; legs, anal legs and gills (if present) are also relatively long; these characters are especially well marked in the 1st stage. The freshly hatched larva is light, usually green; it gradually assumes the coloration of the full-grown larva from the 2nd stage onward; this is already well marked in the 4th stage; the larva is covered with setae and numerous hairlike setae, which gives it a shaggy appearance. The larvae of Hydroptilidae do not build a case in the first 4 stages, live free and are very mobile and active.

Head of larva slightly dorsoventrally compressed, widest in the middle; some setae almost 4 times as long as the width of the head; mandibles shorter and broader than in the full-grown larva, with more numerous and pointed distal denticles on both mandibles.

319 The dorsal sclerites of all 3 thoracic segments (not only of last 2 segments, as in the full-grown larva) do not reach the anterior margin but leave a membranous stripe at the anterior margin. Anterior-angle seta longer than the others in the 1st stage, secondary anterior-margin setae begin to appear in the 2nd stage; setae of series M appear on the pronotum in the 2nd stage; these setae are short, but they are almost as long as the anterior-angle seta in the 4th stage; together with the secondary anterior-angle setae, curved, yellow, anterior-margin setae of series m also appear in the 3rd stage.

The pleurites are not fully developed in the young stages; the horn of the trochantin is still absent in the 4th stage in some genera (Agraylea, Hydroptila, Oxyethira); this hornlike process appears in Orthotrichia and Ithytrichia in the 3rd stage but reaches its full development only in the full-grown larva.

Legs of the young larvae relatively longer than in the full-grown larvae; the forelegs, which are not used in construction, differ little from the other legs; basal process of femur absent, distal process of tibia weakly marked; some setae relatively longer, other setae relatively shorter than in the full-grown larva; the differentiated and specialized setae of the young larva are much smaller than those of the full-grown larva. Claws of legs thin, sometimes very long, without basoventral seta.

Abdominal segments 1—8 of young larvae of some genera with tergites which are not always distinct; they are as wide as the segment but much shorter; posterior margin of tergite situated at the posterior margin of the segment; the segment remains membranous anteriorly; the tergite of the first abdominal segment of Oxyethira is very small, divided into 3 tergites, one median and 2 lateral, which bear an anterior-angle seta; segments 2—8 have not only tergites but also small rounded pleural sclerites with 2 lateral setae. The sclerites bear the 5 dorsal setae, which are well developed in the young larva; anterior-angle and medioanal seta among the longest setae of the body; the posterior lateral setae may also be very long; abdominal segment 9 much more sclerotized (sometimes completely or almost completely) so that only a small median stripe and a stripe near the posterior margin remain membranous ventrally; these membranous areas are also sometimes absent and the sclerite of segment 9 becomes ring-shaped (Ithytrichia).

Unlike in the full-grown larvae, the anal legs of the young larvae of Hydroptilidae are long, with a cylindrical section "b" which is well developed in some genera; this section is sclerotized on the dorsal side, on the sides and partly on the ventral side; the distal part of the sclerite is differentiated in form of a bridge and is a narrow, small plate situated between sclerite "b" and the basal margin of the claw; sclerite "b" with 3 setae, 2 distal setae (dorsal and lateral seta), which are, together with the seta of the bridge of some forms, some of the longest setae of the body; subapical seta of sclerite "b" shorter and thinner. Claw long and thin, slightly curved, with a narrow, transverse, membranous stripe; setae as in the full-grown larva but their length ratio is different; e. g., setae 7 and 8 are long, especially seta 7, which is several times as long as the claw in some genera (Orthotrichia).

**Pupa.** Except for its small size, the pupa of Hydroptilidae does not show any special characters which distinguish it from the pupae of other families. Body spindle-shaped, tapering posteriorly; length of pupae 2.2—5.1 mm.

Head short; antennae usually short, reaching abdominal segments 3—4, abdominal segments 7—8 in male pupae of some species; first antennal segment with 1—3 small setae. Labrum semicircular or trapezoidal, with one or two pairs of setae near the anterior margin and two setae near the posterior margin; posterolateral setae normally developed; all other setae small, spinelike, sometimes rudimentary (Hydroptila). Mandibles weakly curved, their apical part flattened, narrow, with a finely serrate, inner cutting edge; outer setae at the base of the mandible situated close together, behind each other, the shorter seta situated more distally and sometimes curved. Wing sheaths pointed and long. Natatorial setae situated on the tarsi of the midlegs, the dorsal row situated on segments 1—3; the ventral row on segments 1—2. Presegmental plates of holding apparatus on abdominal segments 3—7 oval, sometimes oblong and larger than the postsegmental plates, which are situated on segments 3—5; the spinules on the plates are sometimes arranged in regular rows (Figure 490). The part containing the genitalia of the imago projects slightly at the end of the body.

The case of the pupa is a slightly modified larval case attached to the substrate by attachment disks made by the larva before pupation.

320 Mode of life and habitats. Feeding on algae; living among filamentous algae or plants on stones, in running or stagnant water.

Distribution. Cosmopolitan.

## Key to Genera

### Full-grown larva

1 (2). Very small, 2.2—3.0 mm long; abdominal segments with dark, dorsal sclerites; case slightly dorsoventrally compressed, sometimes barrel-shaped, made of secretion and fine sand grains . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7. **Stactobia** McL. (p. 406)

2 (1). Larger, 3.1—5.5 mm; abdominal segments without tergites; case of different shape.

3 (4). Abdominal segments 2—8 with dorsal and ventral median sucker-shaped processes; case made of secretion, sac-shaped, oval . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6. **Ithytrichia** Eat. (p. 399)

4 (3). Abdominal segments without median processes; case of a different shape.

5 (6). Labrum asymmetrical; second abdominal segment with lateral processes; case with deep grooves and ridges on the convex dorsal surface; ventral surface flat . . . . . . . 5. **Orthotrichia** Eat. (p. 391)

6 (5). Labrum symmetrical or slightly asymmetrical only in the membranous part; abdominal segment 2 without lateral processes; case laterally compressed.

7 (10). Abdomen straight or almost straight, with transverse folds on the middle segments; case made of secretion with algae or of minute sand grains

8 (9). Relatively large, 4.5—5.5 mm; case oval, broader in the middle than at the ends, made of secretion with filamentous algae . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Agraylea** Curt. (p. 352)

9 (8). Smaller, 3.1—4.1 mm long; case bean-shaped, with slightly concave ventral side, made of secretion and fine sand grains, diatoms or silt particles . . . . . . . . . . . . . . . . . . . 2. **Hydroptila** Dalm. (p. 364)

10 (7). Abdomen curved; segments without transverse folds; case made of secretion, without any additional material.

11 (12). Midlegs and hind legs, moderately long, case jug-shaped . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. **Oxyethira** Eat. (p. 373)

12 (11). Midlegs and hind legs very long, about as long as the body; case sac-shaped . . . . . . . . . . . . . . . . . 4. **Leiochiton** Guin. (p. 388)

Young larva

1 (2). Tergites very dark, almost black . . . . . 7. **Stactobia** McL. (p. 406)

2 (1). Tergites different.

3 (6). Abdomen and head of larva with setae which are longer than the legs.

4 (5). Tracheal gills at the end of the body absent. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Agraylea** Curt. (p. 352)

5 (4). Three long tracheal gills at the end of the body . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Hydroptila** Dalm. (p. 364)

6 (3). Setae of head and abdominal segments shorter.

7 (8). Anal legs with very long setae, longer than the body; tracheal gills absent . . . . . . . . . . . . . . . . . . . . . 3. **Oxyethira** Eat. (p. 373)

8 (7). Setae of anal legs not so long.

9 (10). End of body with three tracheal gills . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5. **Orthotrichia** Eat. (p. 391)

10 (9). End of body with one tracheal gill . . . . . 6. **Ithytrichia** Eat. (p. 399)

Pupa

1 (4). Case made of secretion, with a thin covering of fine sand grains or diatoms.

2 (3). Anterior margin of labrum uniformly rounded, with one pair of small, rudimentary setae; case bean-shaped, attached to the substrate at the narrow ventral margin . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Hydroptila** Dalm. (p. 364)

3 (2). Anterior margin of labrum with rounded sides and a small process in the middle, and with two pairs of setae; case slightly dorso-ventrally compressed, barrel-shaped; its ends prolonged in form of short tubes, with which it is attached to the substrate . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7. **Stactobia** McL. (p. 406)

321 4 (1). Case made of secretion or secretion and algae, light, brownish yellow or dark and blackish; covering of mineral particles absent.

5 (8). Anterior-margin setae on labrum absent; case flat, dorsoventrally compressed, light, brownish yellow, attached to the substrate with its broad side, by disks near the anterior and posterior end of the case.

6 (7). Basal setae of mandibles situated behind each other; shorter distal seta projecting outward, case oval, broader in the middle; both ends of the case rounded and similar . . . 1. **Agraylea** Curt. (p. 352)

7 (6). Basal setae of mandibles arranged obliquely; shorter distoventral seta curved and directed forward; case jug-shaped . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. **Oxyethira** Eat. (p. 373)

8 (5). Labrum with one or two pairs of anterior-margin setae; case of different form.

9 (10). Labrum with almost straight anterior margin (Figure 462) and a narrower projecting posterior margin; two pairs of small, anterior-margin setae; mandibles short; case blackish brown, with longitudinal dorsal ridges . . . . . . . . . . . . 5. **Orthotrichia** Eat. (p. 391)

10 (9). Labrum with one pair of widely separated anterior-margin setae; case sac-shaped, like a pumpkin seed. . . 6. **Ithytrichia** Eat. (p. 399)

### 1. Genus Agraylea Curtis

**Full-grown larva.** Length 4.5–5.5 mm. Head sutures not well marked; only a coronal suture and a beginning of frontal sutures (in the 5th stage); distal ends of frontal sutures and ventral sutures absent. Labrum short and broad; setae 5 and 6 several times as long as the labrum. Left mandible with projecting blade, without teeth; small denticles present only near the distal end of the mandible; right mandible without teeth, which are replaced by two tubercles near the distal end; median margin of mandible with a membranous part. Prothorax shorter than meso- and metathorax; only median sternite of prothorax present. Femur of forelegs short, with a large basal process at the ventral margin; distal process of tibia with spinelike setae and other characteristic appendages.

Abdominal segment 1 much larger than metathorax; height and breadth of abdomen increasing gradually toward segments 4 and 5, then decreasing gradually; dorsal medioanal seta of posterior abdominal segments long; dorsal sclerite of abdominal segment 9 trapezoidal; anal legs short, basal part of claw larger than distal part; end of claw bent at a right angle, without dorsal denticles.

Case oblong-oval, broader in the middle than at the ends, made of secretion and algae.

**Pupa.** Labrum rounded anteriorly; both pairs of anterior-margin setae absent. Mandibles long, with a finely toothed blade in the weakly or strongly curved distal part. Natatorial setae situated at the margin of tarsal segments 1–3 of midlegs. Presegmental plates of the holding apparatus much larger than postsegmental plates; number of spinules varying in the different species. The pupal case is directed to the substrate with its broad side like the larval case and is attached by ligaments, which are broader at the end and situated at the sides of the anterior and posterior end of the case.

Mode of life and habitats. Feeding on filamentous algae, in plant thickets, mainly in lakes; also in slowly running rivers.

Distribution. European USSR, Caucasus, Middle Asia, Siberia (rarely in the extreme north). In addition, Europe, Iran, North America.

### Key to Species

#### Full-grown larva

1 (2). Head yellow; two small dark spots, which are sometimes absent, between the eyes in the curvature of the frontal sutures; light spots in posterior part of head indistinct. Dorsal sclerites of thorax without dark spots; mesonotum darker posteriorly than anteriorly;
322 metanotum sometimes almost completely dark, except at the anterior margin . . . . . . . . . . . . 1. **A. multipunctata** Curt. (p. 353)

2 (1). Darker than A. multipunctata; posterior part of dorsal surface of head (sometimes the whole frontoclypeus) grayish brown; a dark, small spot in the curvature of the frontal sutures; a row of 4 dark dots near the bifurcation of the epicranial suture; pronotum with three dark spots; mesonotum and metanotum with one dark spot . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **A. pallidula** McL. (p. 363)

#### Pupa

1 (2). Distal part of mandible relatively broad, slightly curved; presegmental plates with 5—17 spinules; postsegmental plates with 7—16 spinules . . . . . . . . . . . . . 1. **A. multipunctata** Curt. (p. 353)

2 (1). Distal part of mandible narrower and more strongly curved; presegmental plates of holding apparatus with 14—21 spinules and postsegmental plates with 19—23 spinules . . 2. **A. pallidula** McL. (p. 363)

### 1. **Agraylea multipunctata** Curtis

Siltala, 1904b:6—10, Figure 1, a—o. — Thienemann, 1905b:547, 555, Figure III. — Siltala, 1907:384—388, 392, Figure 3, a, b, f, g, d, n, o. — Ulmer, 1909:225, 293, Figures 351, e, 427, a. — Lestage, 1921:441—445, Figure 140, a—h. — Lepneva, 1940:201—202, Figure 152. — Nielsen, 1948:41—62, 135—136, Figures 2, A, 3, A, 4, A, 6, A, F, 8—17, 51, F, G, 52A.

**Full-grown larva** (Figure 388). Length at the beginning of the stage 2.7—2.8 mm; at the end of the stage, 5.0—5.1 mm; ratio of length of head, thorax and abdomen at beginning of stage 10:16.5:35; at the end of the stage 10:17.5:71. Head and prothorax equally broad; meso- and metathorax slightly broader; first abdominal segment much broader than metathorax; height of abdominal segments gradually increasing toward segments 4 and 5, which are the largest segments; the segments become gradually smaller posteriorly; segments 2–8, especially the middle segments, slightly laterally compressed; segments 1 and 9 nearly cylindrical; dorsal and ventral surface of abdominal segments convex, so that the constrictions between the segments appear deep in lateral view, they appear small in dorsal view. Sclerites mainly buff yellow; membranous parts greenish.

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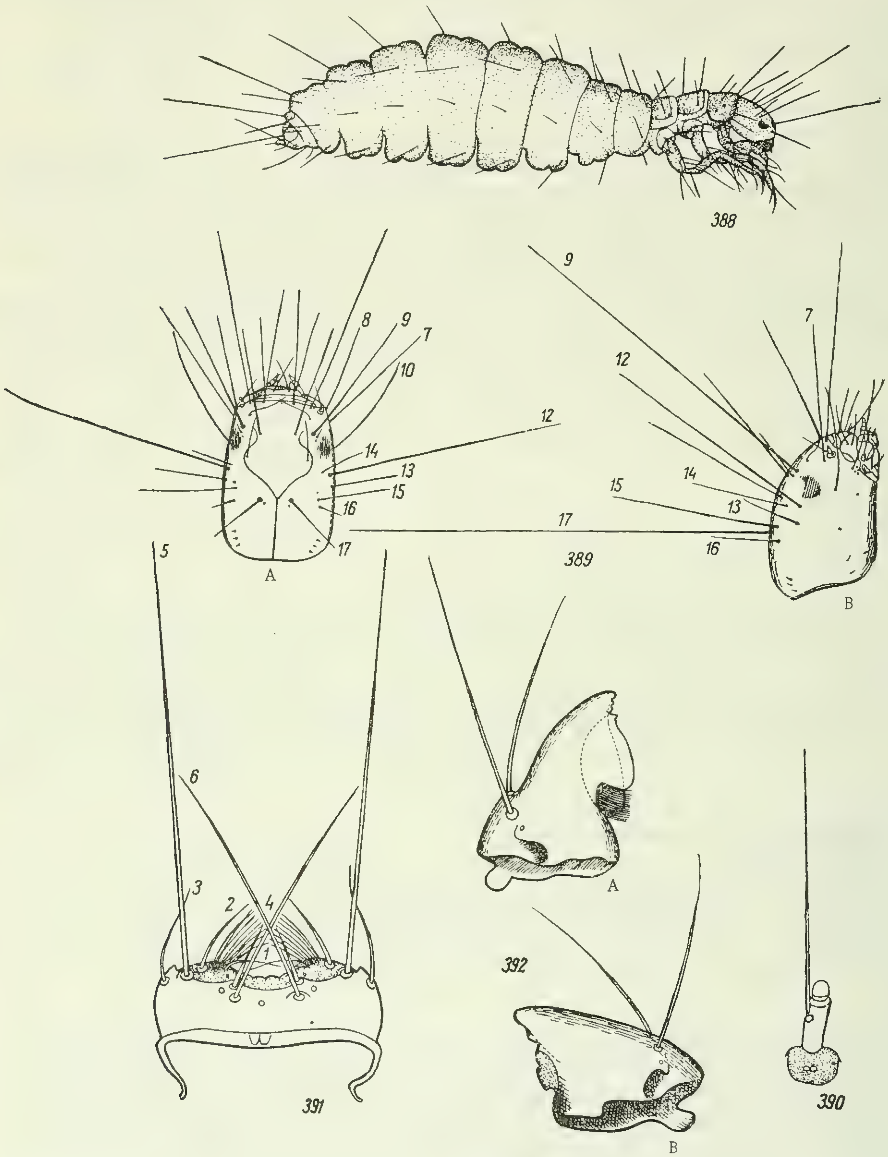


FIGURES 388–392. Agraylea multipunctata Curt. (after Nielsen):

388 – full-grown larva, lateral; 389 – head, dorsal (A) and lateral (B); 390 – antenna; 391 – labrum; 392 – mandibles, dorsal: left (A) and right mandible (B).

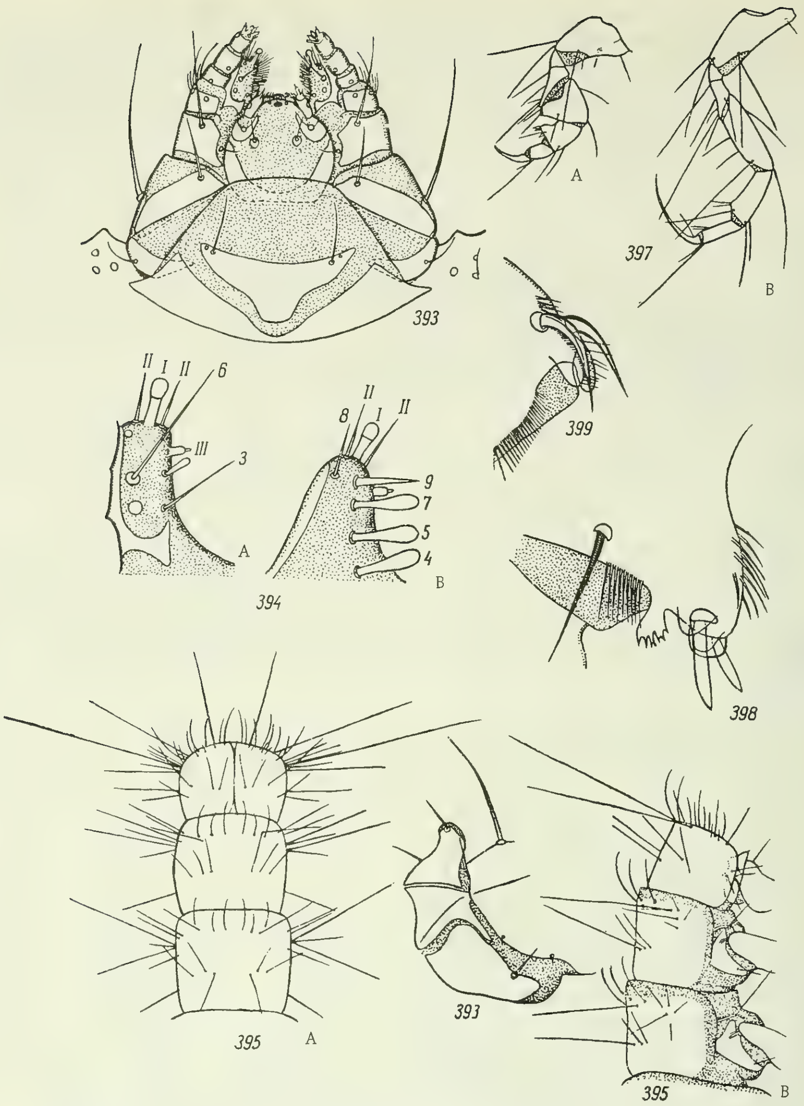
Head oblong (Figure 389); dorsal surface with two small dark spots at the curvature of the frontal sutures; these spots are sometimes absent or fused; Indistinct light spots posteriorly, lateral to the coronal suture; head dark brown anteriorly on the ventral side; occipital foramen with a dark margin. Head sutures little marked; coronal suture and beginning of frontal sutures represented by a thin light line; gular suture absent. Eyes situated at a distance from the anterior margin; antennae situated near base of mandibles; sensilla of antenna relatively short, with a spherical tubercle at the tip and an upward-directed seta in about the middle of the sensilla; membranous base of the antenna with two pits (Figure 390).

Head setae fully developed (Figure 389). Anterior-margin setae of clypeus thin; median seta and especially intermediate seta long; lateral anterior-margin seta and anterior-frontal seta curved toward the middle, recumbent; middle and posterior frontal setae long and thin. Setae 9, 12 and 17 thick at the base, being some of the longest head setae; seta 11 situated near seta 9, small and thin; setae 7, 8 and 10 moderately long, much shorter than seta 9; seta 10 slightly curved, thick at the base; setae 13, 14, 15 and 16 long; seta 16 shorter than the others, slightly thickened at the base, like seta 10; ventral seta 18 small.

Labrum (Figure 391) short and broad; posterior-angle sclerites dark, thin, curved like an S; dorsal sclerite with small processes near the anterior angles; anterior margin of labrum broadly membranous; tufts of long hairs lateral to the shallow median notch; seta 1 thin, curved inward; setae 2, 3 and 4 short, spinelike; seta 6 and especially seta 5 dark, very long.

Mandibles (Figure 392) short and massive; upper blade of left mandible projecting, rounded, with 3 small denticles distally; lower blade without denticles; brush of chetoids situated in the median notch, forming two rows. Median notch hardly marked on the right mandible; lower blade straight;
324 upper blade with two blunt tubercles; the small membranous part in the middle forms two convex folds.

Maxillolabium brown, darker than head; pregula forming a broad plate, which is concave anteriorly and has a median notch (Figure 393); a process of the posterior margin of the submentum with a slightly concave anterior margin and two strong short setae at the sides corresponds to this notch; cardo short, with a thin curved seta; the oblique ventral sclerite of the stipes with a strong seta near the anterior margin; nearby is the small basal lateral sclerite of the stipes with a large laterally-directed, thick, slightly curved seta, which is the longest seta of the stipes. Anterior seta of maxillary palpifer straight, large, situated near the median angle of the sclerite; small basal seta situated on a membrane. Outer sclerite of galea narrow and oblong, with a ventrobasal process (Figure 394); membranous part of galea with numerous hairs; setae 4, 5, 7 and 9 situated mediodorsally in the middle in a longitudinal row, the first 3 setae club-shaped; the last seta spinelike (like setae 3, 6, 8 of the galea); the two sensillae of group I are replaced by a large sensilla; near it are two spines like sensillae of group II; the sensillae of group III are situated ventrally in the middle; one of them is club-shaped, the other is two-segmented. The sclerite of the 1st segment of the maxillary palp covers only part of the ventral and lateral surface; the sclerites of palp segments 2—4 are complete and ring-shaped.



FIGURES 393–399. Agraylea multipunctata Curt. (after Nielsen):

393 – maxillolabium; 394 – galea: right galea, ventral (A) and left galea, dorsal (B); 395 – thorax, dorsal (A), lateral (B); 396 – pleuron of prothorax and base of coxa of foreleg; 397 – posterior view of legs: right foreleg (A); right midleg (B); 398 – tibia of right foreleg, distal part, anteriorly; 399 – tarsus of foreleg, anterior view of distal part.

Mentum blackish brown; anterior margin deeply concave; basal part covered with a membranous fold posteriorly. Ventral sclerites small and round, with a small seta; sclerite of labial palpifer irregularly sickle-shaped; labial palps with a ring-shaped sclerite and two terminal sensillae; apex of labium with a pit lateral to the opening of the spinning gland.

Prothorax (Figure 395) more strongly laterally compressed than meso- and metathorax; pronotum covering the dorsum completely and the sides of the segment partly, reaching its anterior margin; lateral and posterior margin of pronotum brownish black; posterior angles black; area near anterior margin and posteriorly also darker than the background, which is yellowish or yellowish brown. Meso- and metanotum not reaching anterior margin of the segment, leaving a narrow membranous stripe; sclerites darker posteriorly than anteriorly, brownish or brown; dark area on metanotum may occupy the greater part of the sclerite. Pronotum with a long primary anterior-angle seta and a thin, moderately long secondary seta; anterior margin with 3 series of seta, but no primary anterior-angle seta displaced to the surface of the sclerite; the first series of secondary anterior-margin setae consists of 2 long setae, which are almost as long as the anterior-angle seta; the second series consists of 9—11 anteriorly-curved light yellow setae and several straight setae lateral to them; the third series consists of a few small setae posterior to the yellow setae; pronotum with a transverse row of 4 setae, one posteriorly displaced anterior-margin seta and 3 posterior surface setae; 2 setae near the lateral margin. Primary anterior-angle seta on meso- and metanotum shorter than on the pronotum; 4 or 5 short, thin, secondary setae near it; primary anterior-margin seta long; long secondary anterior-margin setae absent; there are 3—4 curved yellow setae; medioanal seta longer than the other 2 surface setae. The appearance of secondary setae and the increase in their number on the dorsum of the thorax in the early stages are shown in the table on p. 361.

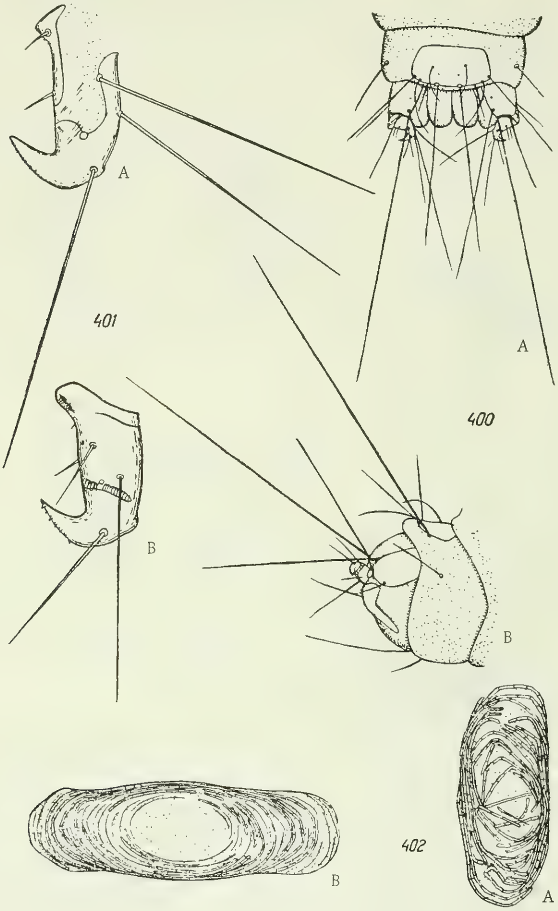
Pleuron of the prothorax (Figure 396) with a narrow membranous stripe on the epimeron; trochantin with a blunt, short, hornlike process with membranous apex; a small, but relatively thick seta on the outer side, near the distal margin; both setules are situated on a sclerite; seta of epimeron situated near the margin of the posterior part. Pleuron of meso- and metathorax consisting of two sclerites in the episternal area, an anterior sclerite including the trochantin, and a posterior sclerite contiguous with the pleural groove; anterior sclerite with a large seta and two setules; epimeron with a long process around the base of the coxa posteriorly; seta short, situated near the anterior margin.

Prothorax with a small single median sternite.

Legs pale yellow; basal margin of coxae brownish black, distal margin brown. Forelegs short (Figure 397, A); distal part of trochanter broad, contiguous with the basal margin of the femur which is markedly enlarged by the ventral process; ventral setae of femur on this process (like adjacent ventrodistal seta of the trochanter) long and spinelike; tibia with a large distoventral process; both distoventral setae form slightly flattened, lanceolate spines; posterior spine slightly smaller than anterior spine (Figure 398); there are 4 chisel-shaped processes between these setae and lateral to them; an additional spatulate process anteriorly, which is divided at the end in a fingerlike manner; anterior seta situated distally, forming a short, dark spine; posterior seta normal and thin; both ventrodistal setae
326 of tarsus (Figure 399) also forming strong, curved spines between which 2 large chisel-shaped processes and a group of very thin spinules are situated; claw of forelegs only slightly longer than tarsus, shining brown;

basal seta of claw short. Ventral setae of femora of midlegs and hind legs spinelike, large and strong; claws of these legs much longer than the tarsi, brown, with long, basal setae (Figure 397, B),

Abdominal segments 2—7 divided into an anterior and posterior part (Figure 388) by a shallow, transverse fold; a similar fold present on the dorsal side of segment 8. There are the following setae on the segments: 328 the medioanal setae, which become longer on the posterior segments, the anterior-angle setae of the dorsum, one of the lateral setae and the intermediate ventral seta are also longer than the others.



FIGURES 400—402. Agraylea multipunctata Curt. (after Nielsen):

400 — abdominal segment 9 and anal legs, dorsal (A) and lateral (B); 401 — claw of anal legs, inner view (A) and outer view (B); 402 — case of 5th-stage larva at the beginning of building (A) and after completion (B).

Dorsal sclerite of segment 9 trapezoidal (Figure 400); anterior-margin seta clearly marked, situated in the middle of the sclerite, curved posteriorly and inward; other setae of dorsum situated near the posterior margin; medioanal seta strong (as on the preceding segments), longer than the others; anterior-angle seta thinner and also long, posterolateral seta slightly thicker (like the anterior-margin seta) and curved posteriorly and inward; short lateroventral seta situated on a small sclerite at the sides of the segment; the other two ventral setae also situated on a small sclerite in the middle; anterior seta short and posterior seta long.

Anus situated between two deep folds. Anal legs situated lateral to the folds, short (Figure 400); sclerite "b" covering the anal leg dorsally and laterally; distodorsal seta of the 4 setae of this sclerite, thick, long, the longest seta of the anal legs; subapical seta and seta on the bridge much shorter; lateral seta situated near the ventral margin, small and thin. Sclerite "c" curved, large, with a short seta. Claw (Figure 401) with relatively large basal part and apical part bent at a right angle. All 8 setae of the claw present: seta 2 in the basal part situated on the outer side near the transverse stripe; seta 1 situated dorsally in the middle; both setae relatively long; seta 3 is the longest seta of the claw, situated dorsally in the middle in the distal part, near the bend; the much shorter seta 6 situated on the outer side medially, the long seta 4 is situated in the basal part near the dorsal margin; short seta 5 situated subventrally, on the outer side; setae 7 and 8 form short spines.

The larva begins to build the case only after molting into the 5th stage; the cases of full-grown larvae may therefore be at different stages of construction (Figure 402); filamentous algae are used much more in the early stages of construction than in complete cases; the algae are not well visible in complete cases, because of the thicker walls and the decomposition of the algae.

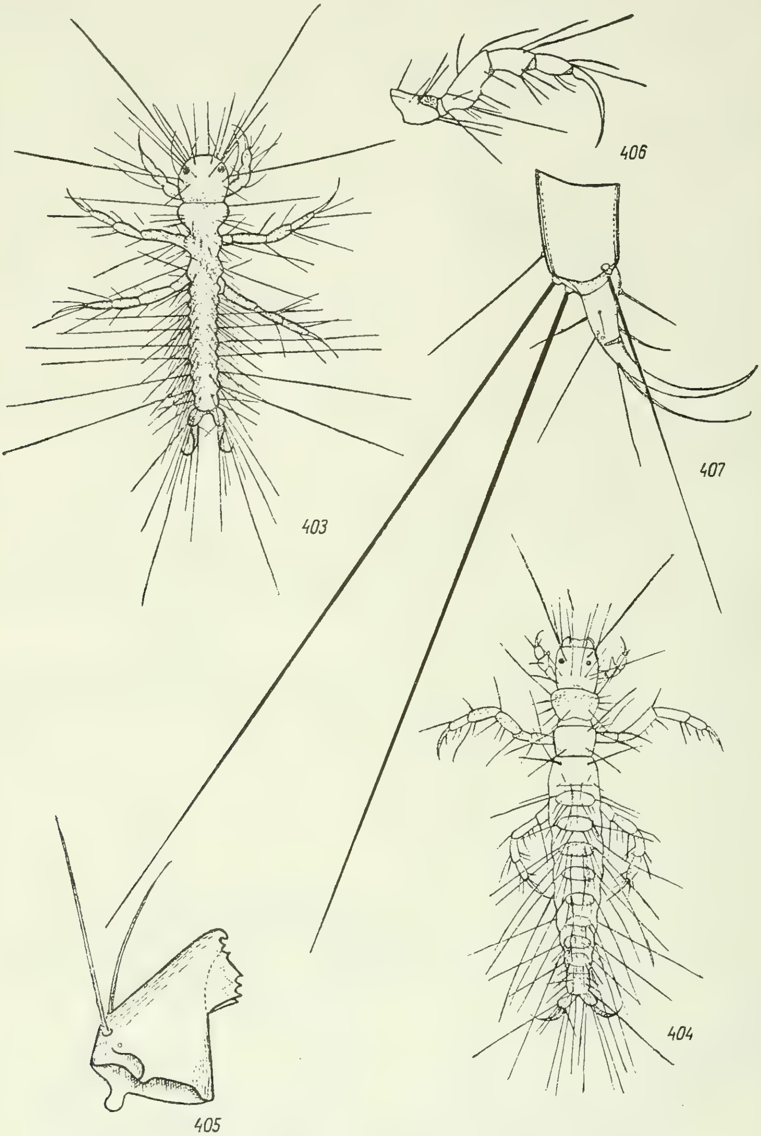
**Young larva.** The most prominent characters of the young larva of A. multipunctata are its generic characters: the rounded head with the extremely long setae 9, 12 and 17, the abdominal setae, which are almost as long as the above setae, and the long, characteristic setae of the anal legs (Figures 403, 404).

The freshly hatched larva is 0.75 mm long; width of head of 1st stage 0.13 mm, of 2nd stage 1.16 mm, of 3rd stage 0.21 mm, of 4th stage 0.26 mm. Membranous areas of the body greenish; coloration of the sclerites changes during development; the sclerites are light in the 1st stage; only head and pronotum are brownish yellow; the margin of the occipital foramen, the posterior margin of the pronotum, the pleural suture and the margin of the coxae become dark in the 2nd and 3rd stage; some characters of the coloration, which are characteristic for the full-grown larva appear already in the 4th stage.

The setae of the head of the young larvae are relatively longer than in full-grown larvae; some of them (e. g., setae 13 and 16) are thinner; the setae are still little differentiated, e. g., the lateral anterior-margin seta and the anterior frontal seta of the frontoclypeus are straight in the 1st, 2nd and 3rd stage and become curved inward only in the 4th stage.

The projecting blades of the left mandible of the young larva (Figure 405) have with well-marked teeth in the 1st and 2nd stage; upper blade with 5 teeth, lower blade with 4; the teeth are still present in the 3rd stage but are reduced; they disappear in the 4th stage; blades on right mandible, well marked in the 4th stage and separated by a notch from the apex; upper blade simple; lower blade with 4 teeth; membranous area of right mandible of the young larva projecting further than in the full-grown larva.

(327)



FIGURES 403–407. Agraylea multipunctata Curt.:

403 – 1st-stage larva; 404 – 3rd-stage larva; 405 – left mandible of 2nd-stage larva, dorsal; 406 – right foreleg of 1st-stage larva (posterior view); 407 – right anal leg of 4th-stage larva (posterior view). (404 – after Siltala; 403, 405–407 – after Nielsen)

The thoracic segments of 1st-stage larva, especially the prothorax, taper posteriorly, this character disappears and the 4th-stage larva resembles the full-grown larva in the form of the thorax. Of the 4 primary surface setae of the pronotum, the pairs of lateral setae are half as long as the 2 median setae, but this difference disappears in the later stages. The 3 primary anal setae on the meso- and metanotum are of the same length in the 1st stage; the median seta becomes longer than the other two in the later stages, as long as the anterior-margin seta and the angle seta. The development of the secondary anterior-margin setae on the thoracic segments is shown in Table 4.*

TABLE 4

(329)

| Setae | Stage | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th |
| Pronotum | | | | | |
| Angle setae .................... | 1 | 1 | 2 | 2 | 2 |
| Dark anterior-margin setae ....... | 0 | 2 | 2 | 2 | 2 |
| Yellow anterior-margin setae .... | 0 | 0 | 4 | 5–6 | 9–11 |
| Seta of the 3rd series, situated slightly posterior to the anterior margin ............. | 0 | 0 | 0 | 1–3 | 4–8 |
| Lateral setae .................. | 0 | 0 | 1 | 1–2 | 2 |
| Mesonotum | | | | | |
| Angle setae .................. | 1 | 1 | 1–2 | 5 | 5 |
| Anterior-margin setae situated medial to the primary seta ........... | 0 | 0 | 1 | 2 | 2 |
| Anterior-margin setae situated lateral to the primary seta ........... | 0 | 0 | 1 | 1 | 1–2 |
| Metanotum | | | | | |
| Angle setae .................. | 1 | 1 | 2 | 5 | 5–6 |
| Anterior-margin setae situated medial to the primary seta ........... | 0 | 0 | 1 | 1–2 | 1–2 |
| Anterior-margin setae situated lateral to the primary seta .......... | 0 | 0 | 1 | 1 | 1–2 |

The setae of the trochantin of the prothorax are relatively longer in the early stages than in the full-grown larva; setae of pleuron of meso- and metathorax shorter.

The differences in length and form of forelegs and hind legs of the young larva (especially in the 1st stage) is little marked in the 1st stage; the forelegs do not have a basal process on the femur or a distal process on the tibia (Figure 406); the cuticular processes characteristic for the legs in
329 the 5th stage are also absent in the 1st stage; the above characters gradually appear during development; the form of the foreleg in the 4th stage becomes more similar to that in the full-grown larva; claws of young larvae much longer than tarsi; the basal seta appears in the 2nd stage (Siltala, 1907: 386–388).

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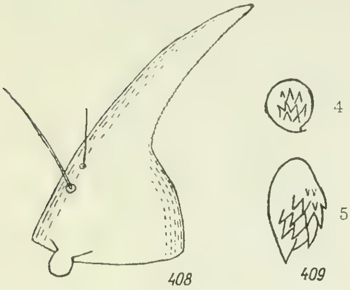
* Only the primary anterior-angle setae are included in the table.

Tergites of abdominal segments 1—8 elliptical; anterior-angle seta remarkably long; medioanal seta of dorsum of abdomen also very long on the anterior segments; this seta is much thicker than the others on segment 9.

Anal legs (Figure 407) long in the first 4 stages; the sclerite of the basal segment covers the greater part of the dorsal side, the whole lateral and ventral sides, so that the segment is membranous only in the middle; the distal seta of the sclerite, the adjacent seta of the bridge are among the longest and thickest setae of the young larva; the dorsal subapical seta of the sclerite, which is relatively short and thin, the lateral distal seta much longer, thick at the base; the medially situated sclerite "c" is small and rounded, with a small thin seta. Claw long, thin at the end, curved, with a narrow, transverse, membranous stripe. Basal part of claw of the young larva completely sclerotized (unlike that of the full-grown larva); the arrangement of the setae is the same, but the differences in length are smaller.



FIGURES 408 and 409. *Agraylea multipunctata* Curt. (after Nielsen):

408 — right mandible of pupa, ventral; 409 — postsegmental plate of segment 4 and presegmental plate of segment 5 (left side).

**Pupa.** Length of male pupae 3.8—4.2 mm; length of female pupae 4.2—5.1 mm; antennae of males reaching the middle of abdominal segment 4, of female pupae the posterior margin of the metathorax. Labrum almost semicircular; both pairs of anterior-margin setae absent; median setae of the 4 basal setae rudimentary; lateral setae long and curved. Mandibles (Figure 408) long, with a broad 330 basal part and a narrow, slightly curved apical part; inner margin of the apical part finely serrated; outer setae straight, situated behind each other; anterior seta shorter than posterior seta.

Wing sheaths pointed, reaching in male pupae the posterior margin of abdominal segment 7, in female pupae the anterior margin of segment 7. Natatorial setae situated at the margin of segments 1—3 of the midtarsi. Presegmental plates of holding apparatus (Figure 409) situated on segments 3—7, large, rounded anteriorly, pointed posteriorly; postsegmental plates situated on segments 3—5, small, rounded; spinules on the plates brown; their numbers are as follows: III:5—14 + 6—14; IV:5—15 + 9—12; V: 7—14 + 3—14; VI: 6—11; VII:7—15; spinules of varying size, some of them very small.

Pupal case attached to the substrate with its broad side by 4 pairs of ligaments near the anterior and posterior end; these ligaments originate at the inner wall of the case near the substrate, near the angles of the slits of the anterior and posterior openings; the ligaments are attached to the substrate by separate, irregularly crossing filaments, which form plates of irregular form; anterior and posterior openings of the case covered with a delicate membrane, which connects both halves of the valve of the larval slit of the case.

*Mode of life and habitats.* In stagnant and running water, in plant thickets; they avoid small and shallow water bodies, like puddles, ponds and stagnant ponds; they inhabit lakes, and are the most common element of the fauna of plant thickets, especially in estuarine parts of lakes; they occur in slowly flowing rivers or rivulets overgrown with plants or in similar water bodies in river floodplains; the species occurs in all zones of plant-thickets, more rarely in the zone of Potamogoton than in other zones; pupation often takes place on the leaves of water lilies.

Distribution. European USSR, extreme northwest of Siberia (rare). In addition, Europe, North America.

### 2. **Agraylea pallidula** McL.

Struck, 1899:342—343, Figure 31; 1900:29—32, Figure 49. — Ulmer, 1903: 132—133; 1909:226, 293. — Siltala, 1904b:11—12, Figure a, b. — Lestage, 1921:441—445, Figure 141.— Lepneva, 1940:202. — Jacquemart, 1958:1—4, Figures 1—11.

**Full-grown larva.** Length 5.5—6.0 mm, height of abdominal segment 5 1.2—1.4 mm. Sclerites yellowish, with a grayish-brown or brown pattern. Dorsal side of head mainly grayish brown; a wide light area near the eye;
331 two dark brown spots at the curvature of the frontal sutures, near the base of the mediolateral setae of the frontoclypeus; similar spots form a transverse row, which consists of two spots on each side near the anterior margin of the coronal suture near the base of setae 17 and 16 (Figure 410); distinct light dots in the posterior part of the head. The mouthparts resemble those of A. multipunctata.

(330)

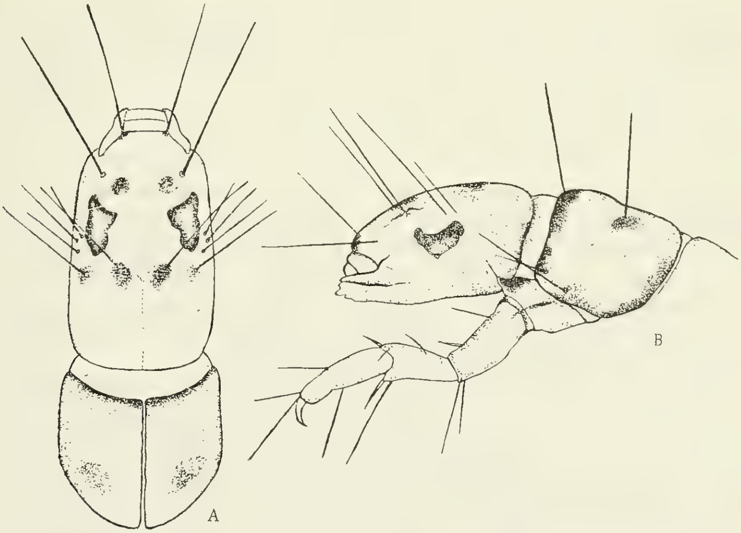


FIGURE 410. Agraylea pallidula McL. Head and prothorax, dorsal (A) and lateral (B)

Main color of thoracic sclerites yellowish; pronotum with a narrow, dark brown stripe near the anterior margin and near the anterior angles; posterior margin blackish brown; two dark brown spots at the sides of each half of the sclerite, near the base of the surface setae; three dark brown spots in each half of the meso- and metanotum; anterior angles of these sclerites also darker than the ground color; indistinct light dots on all 3 thoracic segments in addition to the dark spots. Legs and abdomen as in A. multipunctata.

The case resembles that of A. multipunctata.

**Pupa.** Blades of mandibles narrower and more curved than in A. multipunctata. Both presegmental and postsegmental sclerites of the holding apparatus with more numerous spinules than in A. multipunctata; according to Siltala (1904), the presegmental sclerites bear 14—21 spinules, the postsegmental sclerites 19—25 spinules. The case is usually slightly larger than in A. multipunctata, 7—9 mm long; it is attached to the substrate as in A. multipunctata.

Mode of life and habitats. Larvae living in slowly running water, in plant thickets; characteristic of small rivers and rivulets overgrown with plants in the plains, and of the water bodies of floodplains of these rivers; it occurs in estuarine parts of lakes.

Distribution. South, southeast and west of the European USSR, Caucasus; Middle Asia. In addition, Europe, Iran.

### Genus 2. **Hydroptila** Dalman

**Full-grown larva.** Length 3—4 mm. Head without sutures. Setae 5 and 6 less than twice as long as the labrum. Left mandible with strongly projecting blades; right mandible with a membranous part in the median depression. Sclerites of dorsum of all 3 thoracic segments equally developed, usually dark; prothorax with 3 sternites, a median sternite in the anterior part and two lateral sternites in the posterior part. Femora of forelegs with a basoventral process; tibiae with a distoventral process. Abdominal segments 3—7 strongly convex dorsally and ventrally; intersegmental folds deep; medioanal setae of posterior segments not as long as in Agraylea. Claw of anal legs with three denticles; basal part short. Three tracheal gills at the end of the body: one median gill near the posterior margin of the dorsal sclerite of segment 9; one lateral gill at the sides, near the base of the claw of the anal leg.

Larval case laterally compressed, bean-shaped or kidney-shaped in profile, consisting of two symmetrical halves. Dorsal side convex; ventral side slightly concave; anterior and posterior ends rounded; cases made of secretion, with a covering of fine sand grains or diatoms.

**Pupa.** Length 2.4—3.3 mm. Labrum rounded anteriorly; sides straight or curved; anterior margin with one, rarely two, pairs of rudimentary setae; mandibles long, with thin distal margin; anterior basal seta directed forward, slightly curved. Natatorial setae situated on segments 1—3 of midtarsi. Holding apparatus as in Agraylea. Immature pupa green; it becomes later darker, assuming the coloration of the imago.

Case closed, attached to the substrate with its narrow ventral side, attached by ligaments at the anterior and posterior end; there are often numerous specimens on stones or plants.

Mode of life and habitats. It occurs mainly in running water, in brooks and rivulets with a rapid or slow current; on stones, parts of trees or thickets; rare in lakes.

Distribution. European USSR, Caucasus, Middle Asia. In addition, Europe, Africa, North America, Japan, Australia.

Key to Species

Full-grown larva

1 (2). Labrum with a broad, dense fringe of thin hairs at the anterior margin . . . . . . . . . . . . . . . . . . . . . 1. **H. femoralis** Eat. (p. 365)

2 (1). Labrum without a fringe at the anterior margin.
3 (4). Head of almost uniform color, slightly darker only posteriorly . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. **H. maclachlani** Klap. (p. 371)
332 4 (3). Pattern of head distinct.
5 (6). Sclerotized parts of body generally light; frontoclypeus dark only anteriorly; a small, dark area dorsally, near the occipital foramen; thoracic sclerites slightly dark or mainly light . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4. **H. pulchricornis** Pict. (p. 373)
6 (5). Sclerotized parts of body generally dark; whole dorsal surface of head, except the light spots around the eyes dark; pronotum mainly dark brown; brown anteriorly and laterally; meso- and metanotum dark brown laterally and in the middle; brown in the anterior and posterior parts, except the darker median area . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **H. sparsa** Curt. (p. 371)

### 1. **Hydroptila femoralis** Eaton

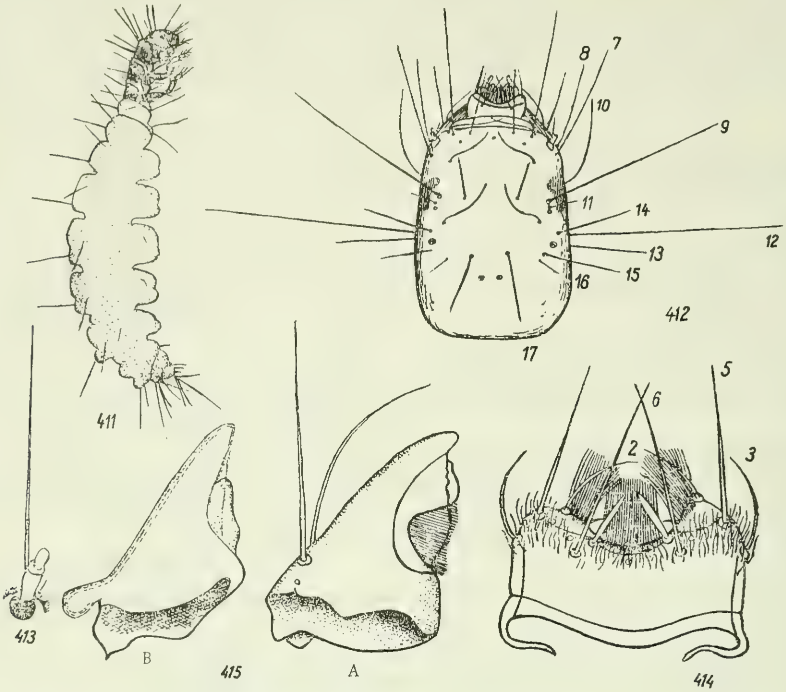
Siltala, 1904b:12–15, Figure 3, a–f. — Ulmer, 1909:224, 292. — Nielsen, 1948:62–76, Figures 3, G, 4, B, 6, B, G, 7, A, B, 18–25.

**Full-grown larva** (Figure 411). Length at the beginning of the stage 1.8 mm, at the end of the stage 3.7–4.1 mm; width of head 0.19–0.23 mm; ratio of length of head, thorax and abdomen at the beginning of the stage 10:19:35; at the end of the stage 10:19:91.

Head relatively small; prothorax slightly broader than head; 1st abdominal segment slightly higher than metathorax.

Head (Figure 412) with strongly convex dorsal surface; head oblong in dorsal view dark brown; a large, light spot, which occupies a large part of the surface near the eyes; antennae shown in Figure 413. Ventral surface of head lighter than dorsal surface. The lateral, anterior margin seta of 333 the frontoclypeus is thin, curved inward; the intermediate seta is the longest; the anterior and posterior frontal setae are also curved inward; middle seta long. Seta 9, which is the longest seta of the head and the small adjacent seta 11 slightly displaced posteriorly to near the posterior margin of the eye; seta 10 thick at base, curved anteriorly; setae 12, 14, 15 and 17 longer than the others (1.5 times as long as the width of the head); seta 18 very small, shorter than the setules in the occipital region.

(332)



FIGURES 411–415. Hydroptila femoralis Eat. (after Nielsen):

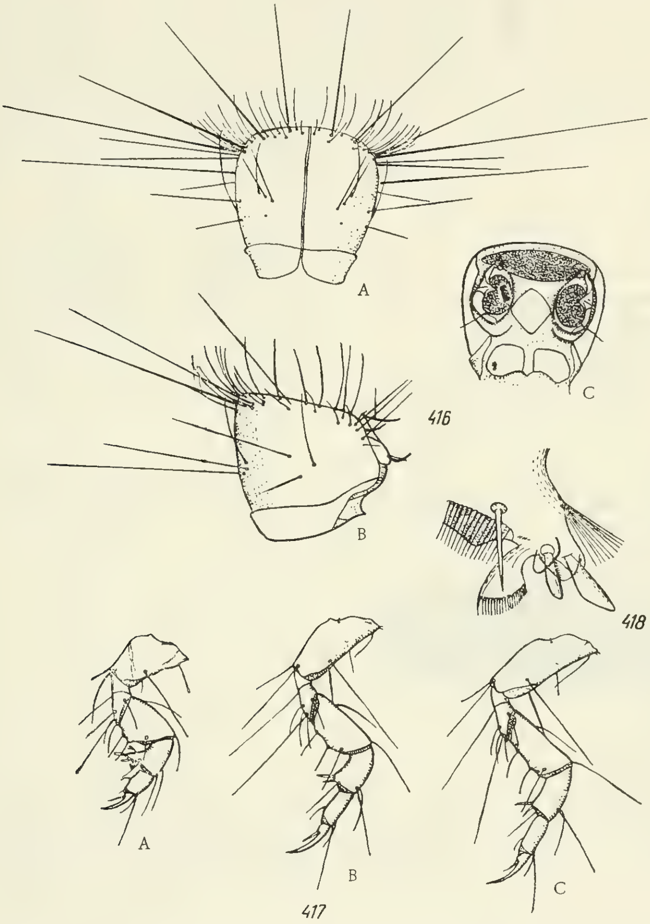
411 – full-grown larva, lateral; 412 – head, dorsal; 413 – right antenna; 414 – labrum; 415 – mandibles: left mandible, dorsal (A) and right mandible, ventral (B).

Sides of labrum (Figure 414) parallel; membranous part of anterior margin broader laterally than in the middle; larger in the right half than in the left half; hairlike spinules long, straight, forming a median group at both sides; 4 setae are situated in a median depression at the margin of the sclerite; they form short, strong pines which are thicker in the middle; setae 5 and 6 equally long; a fringe of dense, thin, short, hairlike spinules
334 near the anterior margin and on the surface of the sclerite.

Mandibles (Figure 415) shining, light brown; process of upper blade of left mandible with deep, basal notch; a small, blunt tooth distally, like on the right mandible; the brush in the medial depression consists of chetoids forming a row; dorsal seta of mandibles almost straight, brown; ventral seta strongly curved, yellow; there are similar thin hairs at its base as on the labrum. Setae of submentum strong, as long as the lateral setae of the stripes.

Prothorax and mesothorax slightly narrower posteriorly, lateral margins of metathorax almost parallel. Thoracic segments slightly laterally compressed; pronotum covering the segment anteriorly and laterally more completely than the sclerites of the other two segments. Posterior margin of sclerite separated from the other part of the sclerite by a ridge, blackish brown; posterior angles and sides black posteriorly; greater part of sclerite dark brown, with minute light spots; buff yellow anteriorly; anterior margin of sclerite with a narrow dark border; the light area in the anterior part of meso- and metathorax extends farther posteriorly than on the pronotum; posterior margin of the sclerites blackish brown, with light spots.

(333)



FIGURES 416–418. Hydroptila femoralis Eat. (after Nielsen):

416 – prothorax, dorsal (A), lateral (B) and ventral (C); 417 – right legs, posterior view: foreleg (A), midleg (B), hind leg (C); 418 – distal process of tibia of right foreleg (anterior view).

Anterior margin of pronotum (Figure 416) with 3 dark long secondary setae in each half; between them short, yellow, curved setae and small setae of the third group; primary anterior-angle seta longer than anterior-margin setae; near it are 2 thin secondary angle setae; the thick seta of the lateral margin is much longer than the thin seta. The 4 primary surface setae are supplemented by 2 secondary setae.

Meso- and metanotum with 4 secondary anterior-angle setae (i. e., 5 setae together with the primary seta); the 3 primary surface setae are supplemented by one secondary seta in the 3rd stage (Table 5).

TABLE 5

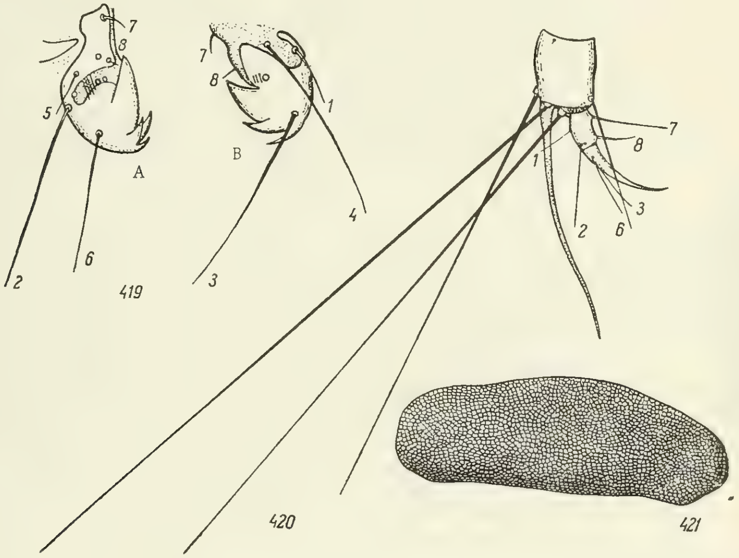
| Setae | Stage | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th (after Nielsen) |
| Pronotum | | | | | |
| Anterior-angle setae ........... | 1 | 1 | 3 | 3 | 3 |
| Dark anterior-margin setae ...... | 0 | 3 | 3 | 3 | 3 |
| Yellow anterior-margin setae ..... | 0 | 0 | 5 | 7–9 | 8–13 |
| Setae, slightly posterior to the anterior margin .............. | 0 | 0 | 0 | 3–4 | 8–9 |
| Lateral marginal setae .......... | 0 | 0 | 1 | 1 | 2 |
| Surface setae ................. | 4 | 4 | 6 | 6 | 6 |
| Mesonotum | | | | | |
| Anterior-angle setae ........... | 1 | 1 | 3 | 5 | 5 |
| Anterior-margin setae: | | | | | |
| median primary seta ......... | 0 | 0 | 1 | 2 | 2 |
| lateral primary seta .......... | 0 | 0 | 1 | 1 | 2 |
| Setae slightly posterior to the anterior margin .............. | 0 | 0 | 0 | 2 | 4–5 |
| Surface setae ................. | 3 | 3 | 4 | 4 | 4 |
| Metanotum | | | | | |
| Anterior-angle setae .......... | 1 | 1 | 3 | 5 | 5–6 |
| Anterior-margin setae: | | | | | |
| median primary seta .......... | 0 | 0 | 1 | 2 | 2 |
| lateral primary seta ........... | 0 | 0 | 1 | 1 | 1–2 |
| Setae slightly posterior to the anterior margin ............. | 0 | 0 | 0 | 2 | 4 |
| Surface setae ................. | 3 | 3 | 4 | 4 | 4 |

Pleural sutures on all thoracic segments black; seta of trochantin of prothorax slightly shorter than seta of epimeron.

Median sternite of prothorax rhomboidal (Figure 416, C), convex; there are two lateral sternites posteriorly, which are separated by a deep groove; mesothorax with only small posterior sternites; metathorax membranous; 335 all sternites lighter than tergites.

Legs (Figure 417) relatively shorter than in Agraylea, brown; midlegs and hind legs with light spots in some places; ratio of lengths of legs 80:100:110. Three flat processes at the end of the distal process of the fore tibia: one between the lanceolate spines and one lateral to them (Figure 418); spatulate process longer than in Agraylea, with a crest of spinules near the distal margin; the anterior distal seta forms a straight, strong spine; posterior distal seta normally developed.

Setae of abdominal segments 1—8 thin; the anterior-angle and medioanal seta are the longest setae. The small anterior-margin seta becomes smaller toward the middle segments; it increases again in size from segment 7 onward; anterior-angle seta almost of the same length on the first 8 segments (1.5—1.3 times as long as width of head); medioanal seta decreasing slightly in size toward the 5th segment (from 1.4 times as long as width of head to 1.3 times as long as width of head); it then increases slightly in length; lateral setae, especially on the middle segments, little marked; medioventral seta of abdominal segments 1—3 dark, paler and smaller on the following segments.



FIGURES 419—421. Hydroptila femoralis Eat. (after Nielsen):

419 — claw of right anal leg, outer and slightly ventral view (A), inner view (B); 420 — right anal leg of 4th-stage larva, outer view (Hydroptila sp.); 421 — case of 5th-stage larva.

Of the 4 setae of the dorsal sclerite of segment 9, the medioanal seta is longer than the others; intermediate and lateral setae shorter than the angle seta; anterior-margin seta curved, directed posteriorly; all setae of the sclerite are black. The 3 distal setae of sclerite "b" of the anal legs are dark and long (but not longer than the medioanal seta of the sclerite of segment 9); lateral seta short; seta of sclerite "c" slightly longer and darker than in Agraylea. Claw short and strong, curved (Figure 419), with a broad transverse, membranous stripe and 3 dorsal denticles; seta 1 is short, situated dorsally in the middle on a membrane near the margin; dorsal seta 2 situated near the transverse stripe,* as long as the median setae 3 and 4; the short, outer seta 5 is situated in the basal part; seta 6 in the distal part is long but shorter than the three above setae; ventral setae 7 and 8 small and spinelike.

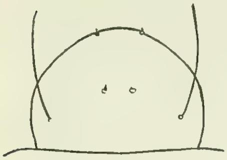


FIGURE 422. **Hydroptila femoralis** Eat. Labrum of pupa (after Nielsen)

336 Three caudal tracheal gills (Figure 420); the median gill slightly longer than the lateral gills.

The case of the full-grown larva is oval at the beginning of construction, it is bean-shaped at the end of construction; the larva enlarges the case, adding first to its anterior, posterior and ventral sides, and when the ventral wall is complete, to the ends; the traces of the initial stage of construction form therefore a small median hump on the dorsal side of the complete case; the ends of the initial stage of construction, which represent the end of construction of the case are visible on the ventral side (Figure 421).

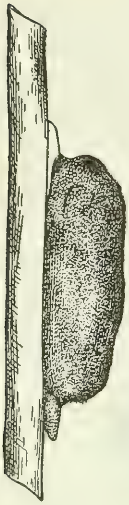


FIGURE 423. **Hydroptila sparsa** Curt. Pupa in its case (after Siltala)

**Pupa.** Length of male pupa 2.4—2.8 mm; length of female pupa 2.8—3.2 mm. Antennae short, reaching in female pupae the middle of the 1st abdominal segment, in male pupae the middle or end of the 3rd segment. Labrum (Figure 422) with broadly rounded anterior margin and curved sides; a pair of short rudimentary setae near the anterior margin; mediobasal setae rudimentary; lateral setae long and curved. The anterior basal seta of the mandibles is short, thin and slightly curved. Wing sheaths long, pointed; they reach the end of the body in males and females. Natatorial setae situated at the margin of segments 1—3 of the mid-tarsi; they are dense, 48—60 in the upper row and 50—69 in the lower row; the setae are longer at the beginning of the row and shorter at its end. Presegmental plates of the holding apparatus present on abdominal segments 3—7 as in **Agraylea**; they are large and pointed posteriorly; postsegmental plates present on abdominal segments 3—5, small and rounded; the number of spinules is as follows: III:5—12+ 8—13; IV:7—11+ 9—13; V:8—15+ 7—16; VI:8—17; VII:11—14. Posterior end of body of male pupa with a rounded process in dorsal view; the processes of the developing lateral lobes of the male genitalia are visible ventrally; penis visible in the middle.

Length of pupal case (which is the closed larval case) 2.9—5.2 mm; the attachment ligaments originate on the inner side of the walls, near the ventral angles of the anterior and posterior slits; the plates of the ligaments are of irregular form; the anterior closing membrane is situated 0.2—0.4 mm from the margin of the case, the posterior closing membrane 0.1 mm or less from the margin.

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* Nielsen (1948:75, Figure 25, C) incorrectly designates seta 2 as seta 6, and seta 6 as seta 2.

Mode of life and habitats. Lakes, rivers and rivulets, on stones, sometimes on plants.

Distribution. USSR: north, west and central part of the European USSR. In addition, southern, Central and northern Europe, Algeria.

### 2. **Hydroptila sparsa** Curtis

Pictet, 1834:225, Plate XX, Figure 11. — Kolenati, 1848:105. — Klapálek, 1897:1—16, Figures 1—6. — Ulmer, 1903:135; 1909:225, 292. — Siltala, 1904b: 16—19, Figure 5, a—h. — Lestage, 1921:449—450.

**Full-grown larva.** Length 3.0—4.0 mm. Ground color of sclerites buff yellow, but the greater part of the sclerites is occupied by dark brown or blackish brown areas, so that the sclerotized parts are darker than in H. femoralis. The whole frontoclypeus and posterior half of the head are dark brown; only the area around the eyes remains light on the dorsal side; more or less distinct light dots on the dark background; ventral side of head lighter.

Pronotum dark brown, in its greater part, with numerous light spots; posterior margin blackish; meso- and metanotum brown, with light spots near the median line; posterior margin of sclerites with a dark border interrupted by light parts.

The complete case is oblong, loose, with a slightly convex dorsal surface and straight ventral surface.

**Pupa.** Length 2.4—3.1 mm. Labrum, like in H. femoralis, with one pair of small anterior-margin setae. Wing sheaths reaching abdominal
337 segment 7 or the end of the body. Posterior margin of end of male pupa with a small median notch in the middle and small lateral lobes at the sides; in dorsal view process of developing penis is visible ventrally.

Pupal case 2.9—4.7 mm long, gray or brownish, lighter than in H. femoralis, more elongate (Figure 423); the attachment plates have no stalks.

Mode of life and habitats. Slowly flowing brooks and rivulets.

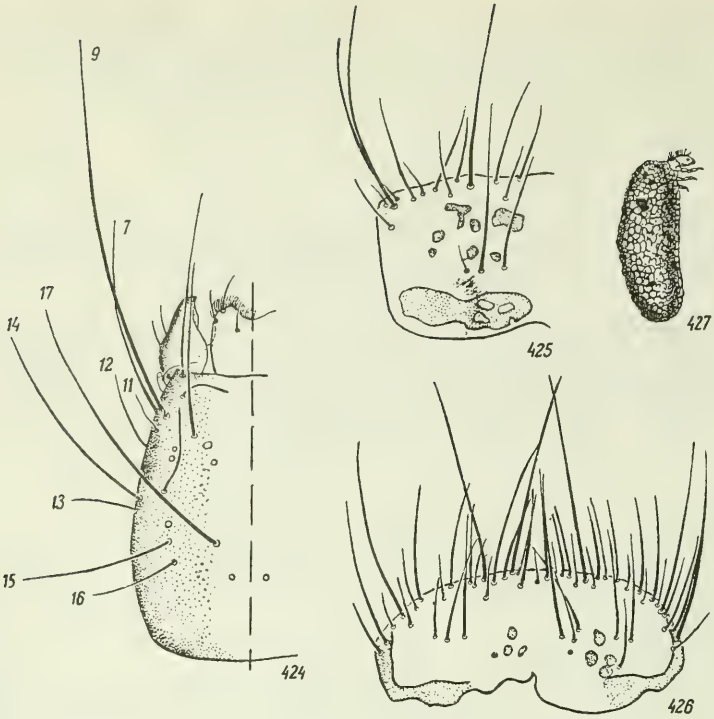
Distribution. USSR: west and northwest. In addition, Europe, Iran.

### 3. **Hydroptila maclachlani** Klap.

Klapálek, 1893:135—138, Figure 37. — Ulmer, 1903:135; 1909:224, 292. — Siltala, 1904b:18—19. — Lestage, 1921:445—449. — Jacquemart et Coineau, 1962:61—76, Figures 65—74.

**Full-grown larva.** Length 3.7 mm, width at abdominal segment 5 0.7 mm. Head brownish yellow, slightly darker posteriorly; light spots on the brown background indistinct; setae as in Hydroptila femoralis, with minor differences (Figure 424).

Labrum with parallel sides; numerous hairs (hairlike spines) near the anterior margin, on the membranous part; dorsal sclerite (unlike in H. femoralis, see Figure 414) without hairs anteriorly near the margin
338 (Siltala, 1904b:19); setae as in H. femoralis (Figure 424). Mandibles brown; blade of left mandible without teeth; a brush of short chetoids in the median depression; ventral side of right mandible with a small blunt, subapical tooth.



FIGURES 424–247. Hydroptila maclachlani Klap.:

424 – left side of head, dorsal; 425 – left side of pronotum; 426 – metanotum; 427 – larva in its case (424–426 – after Jacquemart; 427 – after Klapálek).

Nota of thoracic segments brownish yellow; pronotum (Figures 425 and 426) and mesonotum with a broad dark transverse stripe in each half; large dark dots anteriorly; dark stripe on metanotum narrower, situated only at the sides; there are fewer dots.

Legs yellowish brown, with a characteristic distal process of the tibia and long narrow claws; chaetotaxy of legs as in H. femoralis; seta of claw forming a strong spine.

Dorsal sclerite of abdominal segment 9 small, situated near the anterior margin; medioanal seta situated near the posterior margin, longer than the others; anterior-angle seta also long but shorter. Claw strongly curved, with three small dorsal denticles.

Three tracheal gills, a median gill near the posterior margin of abdominal segment 9 and one gill on the anal legs near the base of the claw.

Case grayish green, bean-shaped, with a covering of fine sand grains (Figure 427); slits at the end of the case broad; case as in other species of Hydroptila, much larger than the larva which moves freely inside it, turns forward and sticks its head either through the anterior or the posterior end of the case.

**Pupa.** Length of male pupa 2.7 mm, of female pupa about 4 mm. Antennae short, filiform. Labrum rounded anteriorly; anterior margin with 2 small median setae in the middle. Mandibles reddish brown. Wing sheaths narrow, pointed, reaching in female pupae the middle of the 7th abdominal segment, the end of the body in male pupae. Grappling apparatus situated on presegmental plates on segments 3–6, postsegmental plates on segments 3–5; it is better developed in male pupae than in female pupae. End of abdomen of male pupa with an obtuse notch in the middle. Case as in the larva.

Mode of life and habitats. Brooks and rivulets, mainly in calm places, among vegetation or on stones.

Distribution. European USSR. In addition, Europe, Algeria, Iran, Pakistan.

### 4. **Hydroptila pulchricornis** Pictet

Siltala, 1904b:15–16, Figure 4, a–f. – Ulmer, 1909:224, 292. – Lestage, 1921, 449.

**Full-grown larva.** Length 3.0–4.0 mm. Larvae light; ground color of sclerotized parts light yellow; dark parts small. Dorsal side of head dark brown posteriorly, with light dots; Frontoclypeus dark only anteriorly; greater part of dorsal surface of head light. Labrum without thin hairs near the anterior margin.

Pronotum with broad, blackish brown border posteriorly and laterally; middle of sclerite brownish, with indistinct light spots; broad stripe in the anterior and lateral parts light yellow. Meso- and metanotum with a brown border posteriorly; a small area near the posterior margin of the segments and an area in the middle, near the median suture, slightly dark; greater part of sclerites light.

Length of case 3.5–5.0 mm; tubercle on dorsum not always present; if absent, the case appears low; covering of case consisting of fine sand grains.

Mode of life and habitats. Rivulets and lakes, among riparian vegetation and on stones.

Distribution. Northwest and north of USSR. In addition, Europe.

## Genus 3. **Oxyethira** Eaton

**Full-grown larva.** Length 2.8–4.5 mm. Head slightly laterally compressed, oblong in dorsal view, uniformly high. Sutures well marked, gular suture, except the anterior branches, forming short posterior branches which surround the small posterior gula; gula separated from pregula by a ridge. Sensilla of antennae longer than in the genera described before; a long curved seta in its middle or slightly nearer its distal end. Setae of head, except a few setae, moderately long; seta 9 is the longest seta of the head. Left mandible with projecting blades; teeth on them small; blades of right mandible little marked and only in its distal part; teeth present only near apex of the mandible.

339 Thoracic tergites narrowing posteriorly; pronotum covering the sides of the segment more completely than on the meso- and metanotum; secondary anterior-margin setae few in number.

Trochantin of prothorax short, fused with episternum and membranous apically; seta of trochantin small, spinelike; setules situated at the sides; membranous stripe dividing the epimeron broad and distinct. Each thoracic segment with a median anterior sternite and two lateral posterior sternites.

Forelegs short; midlegs and hind legs long. Femur of foreleg with a basal process on which the spinelike ventral setules are situated; tibia with a long distal process at the end of which the ventral setae of the tibia are situated; these setae are situated close together and form thick, strong spines; small spinules lateral to the process. Midlegs and hind legs long, thin and straight, trochanters and femora directed upward at rest; tibiae, tarsi and claws are raised above head and thorax and extended forward, so that the thin end of the legs like those of the larvae of Mystacides (Leptoceridae) extend from the case; claws of midlegs and hind legs with a small, thin, light, dorsal spinule in addition to the basal seta.

Abdomen laterally compressed, usually curved; 1st segment, sometimes 1st and 2nd segments much smaller than the others; constrictions between abdominal segments not as deep as in Agraylea and Hydroptila. Anal legs short; claw small, its apex strongly curved, with two small dorsal denticles which bear 2—3 secondary denticles; setae 4 and 5 absent.

Case made of secretion without algae, laterally compressed, bottle-shaped.

**Young larva.** Head of young larva slightly oblong; the body tapers gradually posteriorly from the prothorax in the 1st stage; the abdomen becomes slightly broader only in the area of the anal legs; the middle segments of the abdomen become gradually larger than the posterior segments in the following stages. The mandibles of the young larva are short, the teeth are clearly marked and more numerous than in the full-grown larva. The thoracic segments of the early stages are longer and broader than the abdominal segments; the few secondary anterior-angle setae appear from the 4th stage onward. Distal process of tibia of forelegs present in the 1st stage, but without external spinules; midlegs and hind legs long; they are almost as long as the body of the larva in the 1st stage; the difference in the length of the legs becomes less in the following stages.

The abdominal tergites are represented by a small median sclerite and two very small lateral sclerites which bear the anterior-angle setae; the sclerite of abdominal segment 9 is smaller than in Hydroptila, covering only $^2/_3$ of the segment; the setae of the abdominal segments are longer than those of the full-grown larva but not as long as in Agraylea and Hydroptila. Anal legs moderately long; sclerite "b" of the basal segment with one seta in the 1st stage, which is remarkably long (2 setae in the following stage); intermediate dorsal seta of the sclerite twice as long as the body of the larva in the 1st stage; it is the longest seta in the order Trichoptera; the length of these setae and of the other abdominal setae decreases sharply at the molt from the 4th stage to the 5th.

**Pupa.** Length 2.0—3.0 mm. Female pupae slightly larger than male pupae; antennae of male pupa longer and thicker than those of female pupa, reaching abdominal segment 7, those of the female pupa do not reach beyond segment 3. Labrum with rounded anterior margin and anterior angles; anterior-margin setae usually absent; if present (Ox. sagittifera) they are little marked; posterior-margin lateral setae long; median setae very small.

Mandibles with a broad, massive, basal part and a narrow, long, pointed, apical part which is serrate-denticulate on the inner side.

Wing sheaths pointed and long; they reach the end of the abdomen or beyond it. Dorsal row of natatorial setae present on the segments 1—3 of the mid-tarsi, ventral row on segments 1—2.

Abdomen spindle-shaped; presegmental plates of holding apparatus oblong and situated on segments 3—7; their posteriorly-directed spines are few in number, large, forming a longitudinal row; postsegmental plates rounded; the anteriorly-directed spines on segments 3—5 are slightly smaller than on the presegmental plates.

The pupal case is the modified, closed, larval case attached to the substrate; it is always attached to the substrate with its broad side; the attachment ligaments are situated at the corners of the broad end of the case and at the sides of the neck. The pupa lies in the case with its head toward the broad end and with its dorsum toward the substrate; the broad end of the pupal case thus becomes the anterior end; the side toward the
340 substrate becomes the dorsal side and the outer the ventral side; the neck of the case appears dark, because the exuviae of the last molt are contained there. The case is closed anteriorly, with a curved, narrow membrane; the neck is covered posteriorly with a mesh of threads which form a plug sometimes projecting beyond the neck or situated at a distance from it. The pupa is immobile. The ligaments form disks which are attached to the substrate; the disks consist of a tangle of filaments arranged radially or irregularly; there may be one ligament at the corners with one or two terminal disks, or two ligaments each with one disk; the posterior disks of the neck are situated close together; they are sometimes replaced by a larger median disk. They are usually situated on aquatic plants, sometimes on pieces of wood or stones; in an aquarium without a suitable substrate, the cases are attached to the walls, which facilitates observation of the attachment and closing of the case, and observation of the prepupa, pupation and the change of coloration; the pupa is at first green; it becomes darker before hatching.

Mode of life and habitats. Mainly in plant thickets in stagnant water or water bodies with a slow current.

Distribution. European USSR, Northern Caucasus. In addition, Europe, Africa, India, Sunda Islands, Australia, North and South America.

## Key to Species

### Full-grown larva

1 (8). Outer side of distal process of fore tibia with a brush of short, dark spinules.

2 (7). Dorsal surface of head between the eyes with two dark spots at the base of the mediolateral frontal setae; head yellow or brownish; both blades of left mandible with equal or almost equal small denticles.

3 (6). Antennal seta situated in the middle of the sensilla.

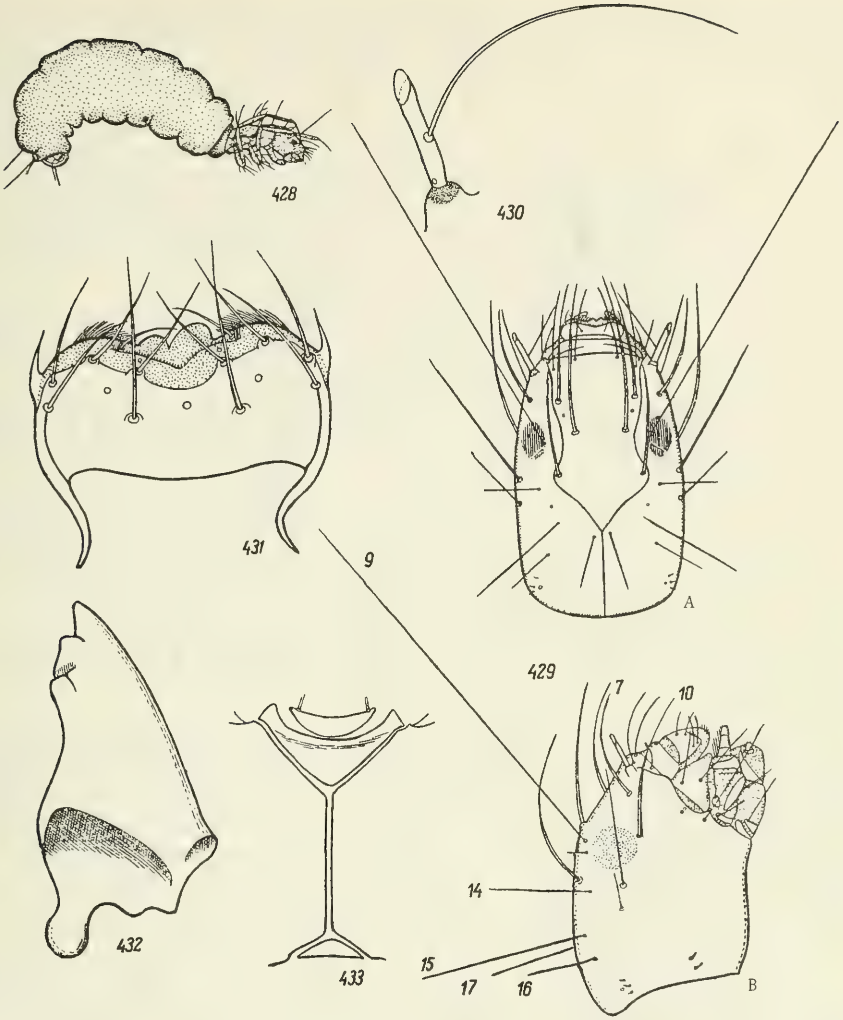
4 (5). Upper blade of right mandible with 2 large teeth; lower blade with one tooth; thorax mainly light yellow . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Ox. costalis** Curt. (p. 376)
5 (4). Upper blade of right mandible with 3 teeth; lower blade with 2 small teeth; there is also one tooth near the blunt distal end of the mandible; thorax mainly brownish . . . . . . . . . 2. **Ox. sagittifera** Ris. (p. 383)
6 (3). Seta of antenna on the sensilla, a third of its length from the distal end . . . . . . . . . . . . . . . . . . . . 3. **Ox. distinctella** McL. (p. 384)
7 (2). Dark spots at the base of the middle dorsal setae absent; head light yellow; upper blade of left mandible with one large, blunt tooth; lower blade with 2 blunt teeth . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4. **Ox. ecornuta** Mort. (p. 385)
8 (1). Distal process of foretibia with a few light spinules on outer side.
9 (10). Head and thorax brown, with light spots in some places; 2 teeth of the upper blade of the left mandible are larger than the others; lower blade with several small teeth . . . . 5. **Ox. friči** Klap. (p. 386)
10 (9). Head and thorax lighter; teeth of left mandible of the same size . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6. **Ox. tristella** Klap. (p. 386)

Pupa

1 (8). Broad end of case with one disk at each angle.
2 (3). Labrum broadly rounded; anterior angles indistinctly marked; sides of broad end of case slightly concave; neck of case moderately long . . . . . . . . . . . . . . 1. **Ox. costalis** Curt. (p. 376)
3 (2). Labrum with rounded, distinct anterior angles; sides of broad end of case almost parallel.
4 (7). Neck of case slightly broadening near the opening.
5 (6). Presegmental plates of abdomen with 4–8 hooks; postsegmental plates with 3–5 hooks . . . . . . . . . . 2. **Ox. sagittifera** Ris. (p. 383)
6 (5). Presegmental plates with 3–6 hooks; postsegmental plates with 9–11 hooks . . . . . . . . . . . . . . . . 4. **Ox. ecornuta** Mort. (p. 385)
7 (4). Neck of case absent . . . . . . . . 3. **Ox. distinctella** McL. (p. 384)
341 8 (1). Angles of anterior end of case with two disks.
9 (10). Anterior margin of case strongly convex; plug of neck of case projecting, hemispherical . . . . . . . . . . . 5. **Ox. friči** Klap. (p. 386)
10 (9). Anterior margin of case straight or slightly convex; plug of neck of case not projecting . . . . . . . . . . 6. **Ox. tristella** Klap. (p. 386)

### 1. Oxyethira costalis Curtis

McLachlan, 1886:17. — Morton, 1887: 201. — Müller, Fr., 1887:337–340. — Klapálek, 1890:204–208, Plate IX, Figures 1–11; 1890:204–208, Plate 9. — Struck, 1900: Plate VI. — Ulmer, 1903:133, Plate III, Figure 73. — Siltala, 1904b:31–33. — Thienemann, 1905b:547, Figure 102. — Ulmer, 1909:226, 293, Figures 348a, 428. — Lestage, 1921:458–463. — Nielsen, 1948:76–95, Figures 2, B, 3, C, 4, C, 6, G, 7, C, 26–33, 52, B, 53, 54–62, B, C, Plate III, Figure 23, 24. — Lepneva, 1940:202.



FIGURES 428–433. Oxyethira costalis Curt. (after Nielsen):

428 – full-grown larva; 429 – head, dorsal (A) and lateral (B); 430 – left antenna; 431 – labrum; 432 – mandible, inner and dorsal view; 433 – head, middle of ventral side.

**Full-grown larva.** (Figure 428). Length at beginning of stage 1.5 mm, at the end 3.3–3.4 mm; ratio of length of head, thorax and abdomen at beginning of stage 10:13.5:24, at the end 10:13.5:72. Larva light; the golden yellow ground color of the sclerites predominates; colored parts light brown, brown or blackish brown; abdomen and other membranous areas green.

Head (Figure 429) slightly compressed laterally, slightly narrower anteriorly; ratio of length to width 1.63, ratio of height to width 1.03.

Head buff yellow, lighter laterally and ventrally, yellowish brown laterally, near the occipital foramen and adjacent parts on the dorsal side; dark spots between the eyes, near the base of the mediolateral setae of the frontoclypeus. Seta on the dorsal side of the sensilla of antennae long, curved inward (Figure 430). Lateral anterior-margin seta of frontoclypeus thin, curved inward; the 2 other anterior-margin setae are thick; frontal setae and setae 7 and 10 slightly curved and inclined forward; setae 12, 13, 16 and 14 dark and strong, relatively short; seta 15 slightly longer than the others; seta 9 is the longest seta of the head, thin, straight, 2.5 times as long as the width of the head; near it is the small thin seta 11; seta 17 situated near the bifurcation of the frontal sutures.

Lateral margins of labrum (Figure 431) rounded; dorsal sclerite with a broad, median notch; posterior-angle sclerites curved; the end of the two longitudinal folds of the ventral surface of the labrum projects forward in the median notch of the membranous part; two pale, broad processes with thin pointed ends project laterally; there are two rows of short, dark spinules which converge in the middle, near the anterior margin of the labrum; there are longer hairlike spinules laterally.

The projecting upper and lower blades of the left mandible with small teeth; brush of hairs in the median depression consists of two tufts; right mandible with 3 teeth distally, two of them on the upper blade and one on the lower blade (Figure 432); outer setae relatively long and thick and curved. Submentum with slightly concave anterior margin and strongly convex posterior margin (Figure 433); 2nd and 3rd segments of maxillary palps fused; last segment of palp with 5 sensillae; labium slightly laterally compressed; mentum short and broad.

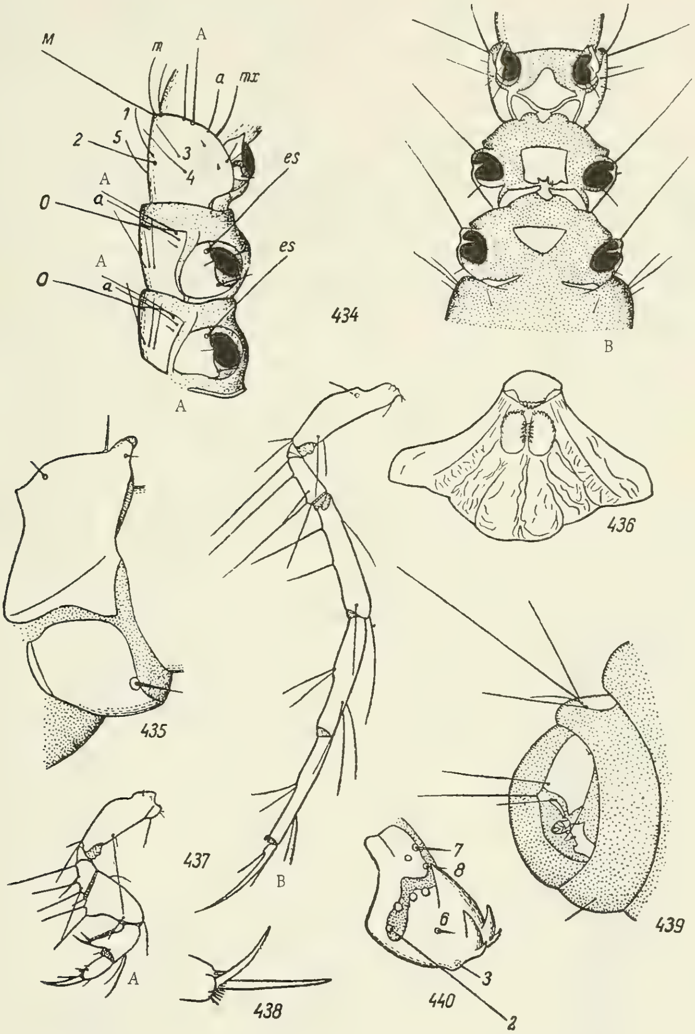
Pronotum covering the anterior part of the segment completely, meso- and metanotum with an anterior, membranous area (Figure 434, A); pronotum extending farther laterally than meso- and metanotum; the pleural sclerites of meso- and metathorax are therefore wider than the pronotum. Each half of the prothorax bears 4 or 5 secondary anterior-margin setae, a long and 3 or 4 short setae; one of the 2 secondary anterior-angle setae short and the other small and setuliform, situated slightly away from the anterior margin; 2 setae are situated at the sides of the sclerite; surface setae situated in the middle of the sclerite, forming two groups; one of the 3 setae of the median group is thin and straight, longer than the others; the other 2 are curved forward; the lateral group consists of two groups situated obliquely behind each other. Meso- and metanotum with a long primary anterior-margin seta; primary anterior-angle seta dark and strong; both secondary setae situated close together, one slightly shorter than the primary seta, the second much smaller; the 3 surface setae of the mesonotum are situated close together, slightly farther from the posterior margin on the mesonotum than on the metanotum.

The distal seta of the trochantin of the prothorax (Figure 435) is situated at a distance from its membranous apex; 2 setules are situated near the anterior margin; seta of episternum of meso- and metanotum straight and long (Figure 434, A); seta of epimeron of all 3 thoracic segments short and thick, situated near the margin.

The median sternite of the prothorax is rhomboidal (Figures 434, B, 436), with a complex sculpture; the two posterior sternites are irregularly

342 triangular; the square median sternite of the mesothorax has an irregular surface; the posterior sternites are narrow and oblong; the median sternite of the metathorax is triangular, with rounded posterior margin; the posterior sternites are rodlike.

(343)



FIGURES 434–440. Oxyethira costalis Curt. (after Nielsen):

434 – thorax, lateral (A) and ventral (B); 435 – pleuron of prothorax; 436 – prosternum; 437 – right foreleg (A) and midleg (B), posterior view; 438 – disto-ventral process of fore tibia, anterior; 439 – segment 9 and right anal leg, outer view; 440 – claw of anal leg, outer and partly ventral view.

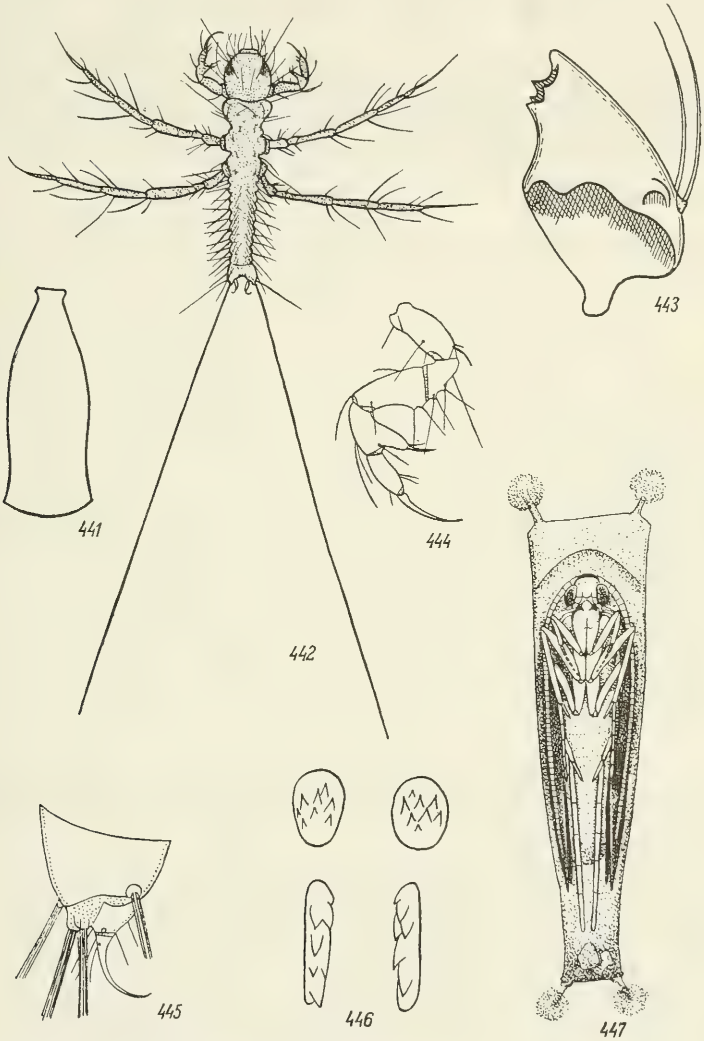
Ratio of length of legs 46:100:103. Basal seta of coxa of forelegs (Figure 437, A) long, spinelike; anterior seta small and thin; the posterodistal seta is the longest seta of the leg; 2 of the 5 ventral setae of the trochanter are light and 3 are dark; the dorsal setae of the femur are thin and curved; both ventral setae of the basal process of the femur are spine- 344 like and long. The two subapical dorsal setae of the mid-tibia are of different length, slightly curved; anterior and posterior distal setae strong; ventrodistal setae short and strong, with small spinules and processes at the base (Figure 438). Subapical seta of tarsus thin; second dorsodistal seta spinelike and displaced anteriorly; ventrodistal setae of tarsus form short and strong spines of different length; at their base are two flat processes with apical spinules; claw slightly longer than tarsus, with a thin basal seta.

The basal seta of the coxa of midlegs and hind legs (Figure 437, B) is light, small, hook-shaped; anterodorsal seta short and thin; posterodorsal seta longer; both situated distally; ventrodistal setae thin and moderately long. The 2 anterior setae of the 5 ventral setae of the trochanter are dark, strong and straight, and are the longest setae of the leg. Femora and tibiae similar in form and size; dorsal setae dark and curved; they are situated subapically on the tibia, close together; anterior seta of femur spinelike; posterior seta short; anterior and posterior seta of the tibia situated near the dorsal setae; this group of 4 subapical setae of the tibia is characteristic for the midlegs and hind legs of Oxyethira; the ventral setae of the femur and tibia are strong, dark and long; setae of the femur are of different length; setae of the tibia of the same length; they are situated close together in the middle of the segment. The thinner, ventral setae of the tarsus are also situated in the middle; dorsal setae shorter than the ventral setae and situated subapically. Claws long, narrow, slightly shorter than the tarsi, with a basal seta and a small dorsal spinule.

First abdominal segment (Figure 428) much smaller than the others; the height of the abdominal segments increases from the 2nd segment onward to the 5th segment, which is the largest segment; the segments then gradually decrease in height; abdominal segment 9 small, with a small, dorsal sclerite. Anterior-angle seta of 1st segment well developed, that of the 5th segment very small; this seta is half as long as the width of the head on the 8th segment; anterior-margin seta of abdominal segments 1 and 9 absent; that of the 2nd segment is a third as long as the width of the head; it forms a setule on the other segments; the well-developed medioanal seta of the abdomen decreases in size on segments 1–5 (from $^4/_5$ of the width of head to a third of the width of the head); it increases in length on the following segments (to half the width of the head on the 8th segment); intermediate and lateral anal setae of abdominal segments 1–3 absent; they are light and small on the other segments. Both pleural setae are small. Only 2 ventral setae present; the median seta on the 1st segment is a third of the width of the head; it is a setule on the following segments. The medioanal seta of the 4 setae at the posterior margin of the sclerite of segment 9 (Figure 439) is longer and thicker than the others; intermediate seta thin and slightly shorter; lateral anal seta thin and directed posteriorly; angle seta dark and shorter than the median seta; both ventral setae equally long.

Anal legs (Figure 439) situated at the sides of the large projecting folds of the anus, short and broad; sclerite "b" of the basal segment almost vertical; one of its 3 distal setae situated on a membrane, another on the bridge; sclerite "c" with a very short seta. Claw (Figure 440) massive, short, with a broad membranous, transverse stripe; thin, basal seta 2 longer than the others; setae 1, 3, 6, 7 and 8 spinelike and short; setae 4 and 5 absent.

(345)



FIGURES 441–447. Oxyethira costalis Curt.:

441 – case of full-grown larva; 442 – 1st-stage larva; 443 – left mandible of 4th-stage larva, dorsal; 444 – left foreleg of 1st-stage larva, posterior; 445 – right anal leg of 4th-stage larva, outer view; 446 – postsegmental plates of segment 4 and presegmental plates of segment 5; 447 – pupa in its case (441–446 – after Nielsen).

Case made of secretion, yellow or yellowish brown, laterally compressed; its end forms a neck; the case differs markedly from the complete case in the early stages of construction (Figure 441); the sides of the latter are slightly concave posteriorly.

**Young larva.** Length of freshly hatched larva 0.55 mm; ratio of head, thorax and abdomen 10:14:5:17.5; width of head in 1st stage 0.11 mm; in the 2nd stage 0.14 mm, in the 4th stage 0.2 mm. The sclerites are pale in the first two stages (Figure 442); the sclerites of head, thorax, legs and abdomen are buff yellow, with a gray tone in the 4th stage; anal legs light yellow.

Seta 9 on the head longer than the others. Mandibles short; denticles on the blades of the left mandible distinct; blades of right mandible each with two teeth (Figure 443). The development of the secondary chaetotaxy of the dorsal sclerites of the thorax is shown in Table 6.

346) TABLE 6

| Setae | Stage | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th |
| Pronotum | | | | | |
| Anterior-angle setae (A, a)....... | 1 | 1 | 1 | 2 | 3 |
| Black anterior-margin seta (M)... | 0 | 1 | 1 | 1 | 1 |
| Yellow anterior-margin setae (m) | 0 | 0 | 1 | (3) 4 | (3) 4 |
| Lateral marginal setae (L, l) ..... | 0 | 0 | 1 | 1 | 2 |
| Surface setae ................ | 4 | 4 | 4 | 4 | 5 |
| Mesonotum | | | | | |
| Anterior-angle setae (A, a) ...... | 1 | 1 | 1 | 2 | 3 |
| Metanotum | | | | | |
| Anterior-angle setae (A, a) ...... | 1 | 1 | 1 | 2 | 3 |

Tibiae of midlegs of the 1st-stage larva with a large distoventral process (Figure 444); midlegs and hind legs much longer than forelegs; length ratio of legs 46:100:103.

Tergite of abdominal segment 1 small in the 1st stage, forming a small bridge between the 2 medioanal setae of the segment; additional small lateral tergites are present on segments 2–8 in addition to the median tergite.

The sclerite of abdominal segment 9 covers about $^2/_3$ of its dorsal surface. The extremely long intermediate distal seta of the basal segment of the anal legs of the 1st-stage larva (Figure 442) of Ox. costalis is twice as long as the larva; the lateral seta is almost as long as this seta in the 4th stage. Claws of the young larva long and thin; setae 1, 4 and 5 absent (Figure 445).

346 **Pupa.** Length of male pupa 2.0–2.3 mm, of female pupa 2.4–2.7 mm; antennae of male pupa reaching abdominal segment 7; antennae of female pupa reaching abdominal segment 3. Head setae pale. Labrum with indistinct, anterior angles and projecting anterior margin. Mandibles with thin, long blades, which are finely serrated on the inner side. Wing sheaths reaching beyond the end of the abdomen, in the male pupae slightly so, in females distinctly. Postsegmental plates of segment 4 and presegmental plates of segment 5 shown in Figure 446; number of spinules on the plates of segments 3–7 as follows: III:4–9 + 6–11; IV:3–7 + 7–13; V:3–8 + 8–12; VI:4–9; VII:4–8; the increase in the number of spinules corresponds to their decrease in size.

The anterior (broad) end of the pupal case is convex; the ligaments are short and situated at a distance from the angles of the case; the disks consist of radially diverging filaments; posterior disks resembling the anterior disks, but the ligaments are thinner (Figure 447).

Mode of life and habitats. Stagnant water bodies and water bodies with a slow current, in plant thickets.

Distribution. European USSR, northwest, west, central belt and southeast. In addition, Europe, Egypt.

### 2. **Oxyethira sagittifera** Ris.

Siltala, 1904b:24–29, 32–33, Figure 8, a–m; 1907:384–389, 393, Figure 3, d. e. — Lestage, 1921:458–464.

**Full-grown larva.** Length 2.7–3.0 mm. Habitus as in Ox. costalis. Head oblong, light yellow, slightly darker at the base of the mouthparts and near the occipital foramen; dark spots present near the base of the middle, frontal seta; seta 9 longer than width of head; There are two rows of small, light spinules which form an angle in the median notch near the anterior membranous margin of the labrum. Blades of left mandible with small, blunt denticles; right mandible with a blunt apex and a large, subapical tooth which is separated from the other part of the mandible by a notch; upper blade of right mandible with 3 small teeth; lower blade with 2 or 3 small teeth.

Pronotum lighter than the other segments; its posterior margin, sides and anterior angles blackish; posterior half of sclerite darker than anterior half; Posterior margin, sides and anterior angles of meso- and metanotum, blackish; dorsal setae of thorax as in Ox. costalis. Thoracic sternites blackish brown, resembling those of Ox. costalis.

Length ratio of legs 45:100:102; basal margin of coxae blackish. Segments of midlegs and hind legs darker in the basal part than in the apical part; the forelegs appear therefore lighter than midlegs and hind legs. A row of small, dark spinules on the outer side of the anterior process of the fore tibiae (as in Ox. costalis); claws of midlegs and hind legs with small light, dorsal spinules. Claws of the holding hooks with three small dorsal denticles.

347 **Pupa.** Length 2.2–3.3 mm. Antennae of male pupae reaching abdominal segments 5–6, those of female pupae segment 2; antennae moniliform, segments as broad as long or slightly broader than long. Labrum broad, with

straight sides, rounded anterior margin and distinct anterior angles; 2 anterior-margin setae rudimentary; 2 small median setae and 2 long lateral setae posteriorly. Mandibles with a long distal part which is serrated on the inner side; outer basal setae of different length.

The oblong presegmental plates of the holding apparatus of segments 3–7 bear 4–8 spinules, the postsegmental plates of segments 3–5 with 4–13 spinules. Posterior margin of segment 8 of the male pupa concave, dorsally penis visible ventrally in the middle; there are lateral lobes; end of the body with two median groups of spinules on the ventral side; end of female pupa blunt, with two lobes. Case 3–4 mm long; anterior angles with one disk or rarely two small disks on each ligament; posterior disks sometimes situated close together; they are sometimes replaced by one disk with two stalks; case yellowish green or grayish.

Mode of life and habitats. Rivulets and in plant thickets.

Distribution. USSR: northwest of the European part. In addition, Europe.

### 3. **Oxyethira distinctella** McLachlan

Lepneva, 1928:37–39, Figures 3 and 4.

**Full-grown larva.** Length 2.5–3.0 mm. Head light yellow; a narrow brown border near the occpital foramen; dark spots at the base of the middle frontal setae (Figure 448); frontoclypeus (Figure 449) dark in the middle, with indistinct spots posteriorly. Antennal seta situated subapically on the sensilla, at $^2/_3$ of its length (Figure 450). Pronotum light yellow anteriorly, brown or dark brown laterally and posteriorly; its posterior margin with a dark brown border; mesonotum light yellow in its greater part; its posterior margin with a narrow brown stripe; metanotum brown, dark brown posteriorly. Prosternum (Figure 451) and mesothoracic sternites brown; median sternite of metathorax indistinct, light yellow, irregularly triangular. Distoventral process of tibia of forelegs with a row of short, thin, dark spinules which form a brush on the outer side (Figure 452).

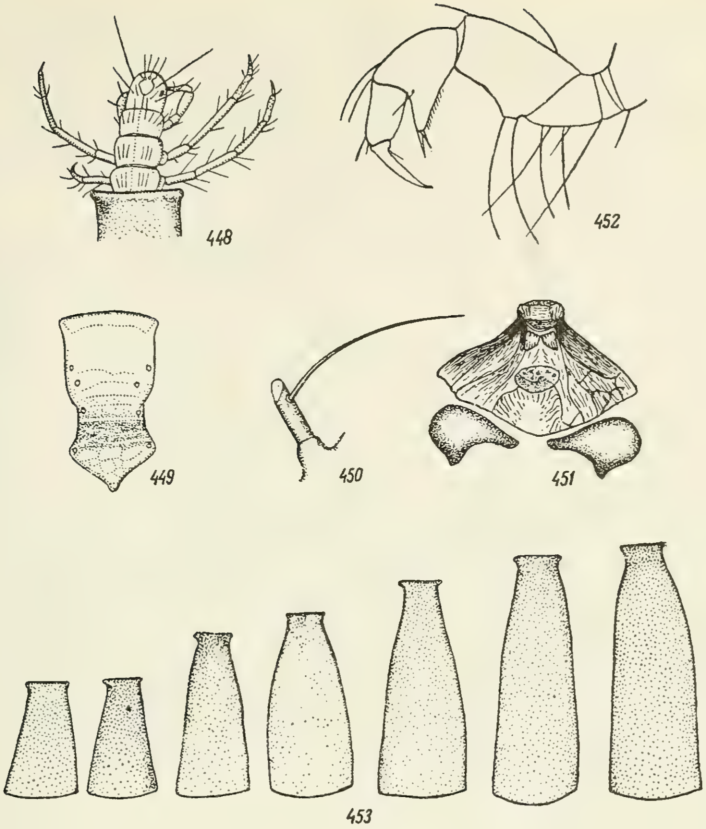
Abdomen slightly curved.

Case (Figure 453) with a short neck; anterior opening broad; sides of the case parallel posteriorly.

**Pupa.** Length 2.9–3.0 mm. The broad anterior end of the case is slightly convex, almost straight; each angle with one disk.

Mode of life and habitats. Plant thickets in stagnant and running water with a slow current; they prefer calm parts of thickets of water lilies and broad-leaved Potamogeton in lakes; they avoid the open littoral with reeds and Scirpus; pupae are found in June, July and August. They have been found in lakes Segozero, Bygozero, Sandal and the lakes of the Vygoonezhskii watershed in Karelia.

Distribution. Northwest of the European USSR. In addition, Europe.



FIGURES 448–453. Oxyethira distinctella McL.:

448 – head, thorax, legs and anterior end of case, dorsal; 449 – frontoclypeus; 450 – antenna; 451 – prothoracic sternites; 452 – left foreleg, outer view; 453 – different stages in the construction of the case.

### 4. Oxyethira ecornuta Morton

Siltala, 1904b:30–31, 33, Figure 10, a–d. – Lestage, 1921:458–464.

**Full-grown larva.** Length 3.1–3.3 mm. Larvae light; sclerotized parts light yellow; pattern little marked. No dark spots near the base of the middle frontal setae of the frontoclypeus. Light dots in the posterior part of the head; upper blade of left mandible with one tooth, lower blade with 2 teeth; right mandible with one blunt tooth lateral to the large terminal tooth. Mesonotum and metanotum with black anterior angles and black posterior margin; sides with a narrow dark border. Distal process of fore tibia with a distinct crest of small, dark spinules; midlegs and hind legs slightly darker than forelegs.

**Pupa.** Length 2.6–3.0 mm. Presegmental and postsegmental plates small, pale; presegmental plates with 3–6 denticles, postsegmental plates with 9–11 denticles. Posterior end of male pupae blunt; penis broad at the end and two small ventral lobes below it.

Pupal case 3.0–4.1 mm long, grayish or light yellow, transparent; sides of the case almost parallel posteriorly; anterior margin slightly convex, almost straight; posterior membrane situated inside the neck, not visible outside; each angle of the anterior margin with one disk; disks with stalks
348 thin; 2 posterior disks with short stalks, which are sometimes replaced by one large median disk without a stalk.

Mode of life and habitats. Mainly in plant thickets.

Distribution. Northwest of the European USSR. In addition, Northern Europe.

### 5. **Oxyethira friči** Klapálek

Siltala, 1904b:29–30, Figure 9, a–g. – Ulmer, 1909:226, 293, Figure 428, b. – Lestage, 1921:458–464.

**Full-grown larva.** Length 2.8–3.0 mm. Larvae darker than those of other species; sclerotized parts brown; pattern dark. Head dark brown, without pattern; frontoclypeus without dark spots, with light spots in some places. Upper blade of left mandible with 2 large projecting teeth and a small tooth between them; lower blade with several small teeth.

Pronotum slightly lighter near the anterior margin than the other uniformly brown area; there are indistinct light spots in some places;
349 lateral and posterior margin with a narrow blackish brown border; anterior half of meso- and metathorax (especially anteriorly) dark brown, darker than the ground color; anterior and posterior angles and lateral part of posterior margin black. Thin, light, sparse hairs on the outside of the process of the fore tibia.

**Pupa.** Length 2.1–2.7 mm. Antennae of male pupae reaching the 7th abdominal segment. Presegmental plates of abdomen oblong, with large spines in longitudinal rows. Posterior end of male pupae rounded dorsally; penis blunt, broadened at the end; end of body without two ventral small lobes covered with spinules. Length of pupal case 3.0–4.1 mm, width of neck 0.4–0.5 mm, width of posterior end 1.1–1.2 mm; broad margin of case strongly convex, narrow, with a laterally projecting membrane. Angles of the broad raised anterior margin with two attachment disks with separate stalks, which originate in one point; sides of narrow part of case with two disks, which are sometimes replaced by one large median disk or by 3-5-6 disks; these disks are rarely without stalks. Case yellowish brown; old cases left by the pupae are dark brown, sometimes blackish.

Mode of life and habitats. Running water, on the bottom; pupae on stones.

Distribution. European USSR, northwest and central belt. In addition, northern and Central Europe.

### 6. **Oxyethira tristella** Klapálek

Klapálek, 1897:11–16, Figures 5–6. – Ulmer, 1903:133. – Lestage, 1921:463–464.

**Full-grown larva.** Length 4.0 mm. Resembling Ox. costalis but the color is lighter; sclerites uniformly light, dark parts small. Head oblong, 1.5 times as long as broad, yellowish white, without pattern; seta on sensilla of antenna situated at $^2/_5$ of its length from the apex; middle frontal seta of frontoclypeus thicker than the others; seta 9 long, straight and thin. Upper and lower blades of left mandible with one tooth; a narrow but deep notch at the lower blade near this tooth; teeth more distinct and larger than in Ox. costalis; two distal teeth on the right mandible; end of the mandible slightly broadened.

Thoracic tergites yellowish white; a narrow brown border at the margin; angles chestnut brown; posterior half of pronotum darker than anterior half, brownish; thoracic setae as in Ox. costalis. Ratio of length of legs 50.5:100:107.3; distal process of tibia of forelegs with a row of short dark hairs on the outside; midlegs and hind legs relatively slightly shorter than in Ox. costalis; femora, tibiae and tarsi of midlegs and hind legs darker than trochanter and coxa; the claws are shorter relative to the tarsi than in Ox. costalis: this ratio is 1:1.1 in Ox. costalis, it is 1:1.3 (midleg) and 1:1.4 (hind leg) in Ox. tristella; femora, tibiae and tarsi of legs darker than trochanter and coxa. Abdomen as in Ox. costalis. Sclerite of segment 9 yellowish brown; claw of holding hooks with two dorsal denticles.

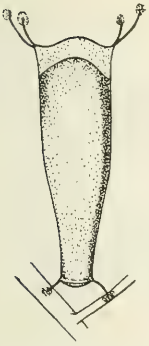


FIGURE 454. Oxyethira tristella Klap. Pupal case (after Klapálek)

Case resembling that of Ox. costalis; its broad part slightly concave on the dorsal and ventral side; neck not as distinct as in Ox. costalis; it resembles the narrow part of the larval case of Ox. distinctella more closely.

**Pupa.** Length of male pupae 2.46 mm, of female pupae 3.38 mm. Antennae of male pupae with 35 segments (43 in Ox. costalis), reaching the end of segment 6; antennae of female pupae with 25–26 segments, reaching the 2nd abdominal segment. Unlike Ox. costalis and related species, the labrum is trapezoidal, with rounded anterior margin, straight sides and distinct anterior angles; 2 small anterior-angle setae present; 2 median setae on the posterior margin distinct; lateral setae not as long as in other species; outer basal setae of different length, as in other species of Oxyethira. Wing sheaths pointed, reaching the end of the abdomen in female pupae and slightly further in male pupae.

The oblong presegmental plates with a few posteriorly-curved denticles (Klapálek (1887) mentions only 3 or 4 denticles), which form a short
350 pointed group (as in other species of Oxyethira); postsegmental plates rounded, pale on segments 3 and 4, more distinct on segment 5.

Pupal case (Figure 454) attached to the substrate by two pairs of ligaments at the corners of the anterior margin; each ligament has a separate small disk, one of them markedly smaller than the other; each side of the neck with one ligament with a disk, which is slightly larger than the anterior disks; posterior and often with 3 or 4 ligaments; membrane at posterior margin of neck convex and slightly projecting.

Mode of life and habitats. Running water, in the rapid current of small rivulets in the plains.

Distribution. European USSR, northwest, west and central belt. In addition, northern and Central Europe.

## 4. Genus **Leiochiton** Guinard

**Full-grown larva.** Length 3.5–4.0 mm. Sensilla of antennae slightly shorter than in Oxyethira; seta light, curved inward; the longest seta after seta 9 is seta 15, which is directed obliquely posteriorly; it is thin, hairlike and soft at the end. In addition to the primary anterior-margin seta, the mesonotum bears also a short, yellow, curved seta.

Distal process of tibia of forelegs with a spatulate, divided chetoid on one side resembling that of Agraylea; the other side with sparse, light hairs; the tibia is the longest segment of midlegs and hind legs; a dorsal spinule absent on the claws.

Abdomen curved; abdominal segments 1 and 2 much smaller (narrower and lower) than the following segments; there are small, rudimentary tergites near the anterior margin of segments 3–8; claw of anal legs with 2 dorsal denticles and 3 additional small hooklike spinules above them.

Case made of secretion, sac-shaped, with convex sides and anterior and posterior openings of the same size.

**Pupa.** Wing sheaths pointed and long. Anterior angles of case with 2 attachment disks, each with a stalk; posterior angles of case each with one attachment disk.

Mode of life and habitats. Stagnant water, in plant thickets; it occurs in large numbers in floodlands in the Volga delta.

Distribution. European USSR. In addition, Europe.

### 1. **Leiochiton fagesii** Guinard (Oxyethira fagesii Guinard)

Ulmer, 1909:225, 293. — Lestage, 1921:458–464.

**Full-grown larva** (Figure 455). Length 3.5–4.0 mm. The largest larva of Hydroptilidae in the USSR: the larvae differ from larvae of Oxyethira in the narrow, long thoracic segments, the length of midlegs and hind legs, the characteristic curvature of the abdomen, the relatively narrow first two abdominal segments and the very large segment 4, which is the largest segment of the abdomen.

Head light yellow, mouthparts only slightly darker; occipital foramen with a narrow brown border; antennae slightly shorter than in species of Oxyethira, with a long, inward-curved seta. Frontoclypeus with 3 dark dots laterally, between the middle and posterior setae; one large dark dot in the middle of the sclerite; the large dark dots with their partly connected margins form a dark bridge in the middle of the sclerite. The most outer anterior-margin seta thin, curved inward; median seta longer and thicker than the others; intermediate seta also long; anterior and posterior frontal setae longer than the middle seta; posterior seta curved anteriorly. Setae 7 and 8 thin and slightly curved; seta 9 and seta 11 are situated between the eye and the curvature of the frontal sutures; it is dark, thin, projecting and much longer than the others; seta 15 also long but soft and thin, directed posteriorly; setae 17 strong and dark. Dorsal sclerite of labrum brownish; setae brown. Sclerites of maxillolabium brown; mentum dark brown; submentum crescent-shaped.

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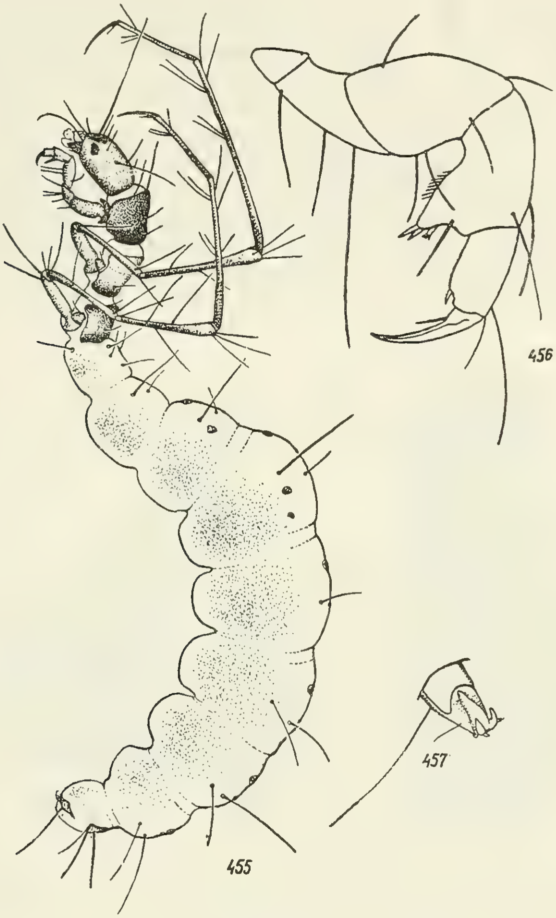

FIGURES 455–457. Leiochiton fagesii Guin.:

455 – full-grown larva, lateral; 456 – right foreleg, posterior; 457 – claw of anal leg, ventral.

Pronotum darker than meso- and metanotum, brown; its posterior margin is separated by a groove and slightly darker; mesonotum light

yellow, with a broad dark brown posterior margin; metanotum light brown, with dark brown posterior margin. Pronotum with the upward-directed seta M, anteriorly-directed setae A and a, and 3 yellow setae of group m near the anterior margin; the 2 median setae of the latter group are curved anteriorly and the lateral seta is straight; seta L near the lateral margin; the small setae l are not marked; surface setae situated in the middle of
351 the sclerite; the median group consists of 3 setae (1, 2, 5) the lateral group of 2 setae (3 and 4) situated behind each other. Two setae (O and m) in the middle of the anterior margin of the mesonotum; angle of sclerite with 3 setae (A, a, $a_1$); angle of metanotum with 4 setae (A, a, $a_1$, $a_2$). There are 3 primary surface setae situated close together near the posterior margin of the metanotum; they are situated slightly away from the posterior margin, on the mesonotum.

The horn of the trochantin of the prothorax is fused with the episternum; it is brown on the outer side; distal seta at the base of the membranous apex short and thick; transverse membranous stripe of epimeron broad, as in the other species; seta of epimeron longer than the other setae of the pleuron. Setae of the pleuron of meso- and metathorax similar; episternum complete, with a longer seta; seta of epimeron shorter but thicker.

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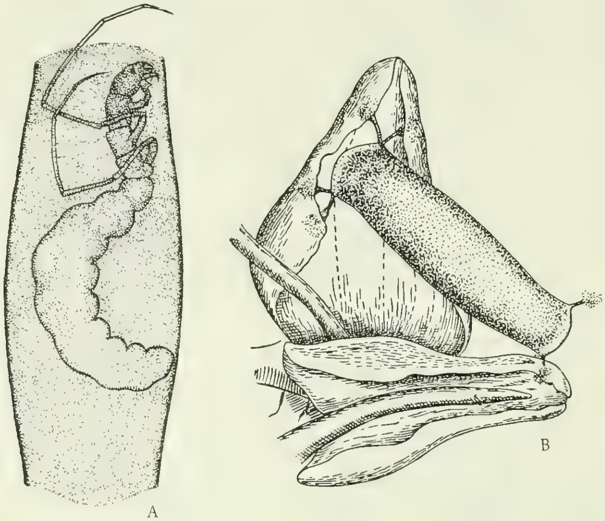


FIGURE 458. Leiochiton fagesii Guin. Larva in its case (A), pupal case on a leaf of Potamogeton (B)

Forelegs (Figure 456) different from the other legs as in species of Oxyethira; distal process of tibia with 2 ventral setae which form light and strong spines; anterior spine of this group shorter than the posterior;
352 a spatulate process with short, dark setuliform spinules on the ventral side of the segment near the apex of the process; pale sparse hairs basal to this process. The longest segment of midlegs and hind legs is the tibia;

ventral setae of femur almost equally long; dorsal subapical setae of tibia situated near its end, like the dorsal and ventral setae of the tarsus; claw thin, long, but markedly shorter than the very long tarsi and with a strong basal seta.

A remarkable character of the abdomen are distinct, small, round or oval tergites on segments 3–8; these tergites are situated near the anterior margin of the segment and are not connected with the base of setae; medioanal and anterior-angle setae of abdomen dark and longer than the others, seta 1 of the 2 ventral setae of the 1st abdominal segment, dark and strong. Claw of anal legs with two dorsal denticles and hooklike spinules above them (Figure 457).

The case is made of secretion, with thin transparent walls; anterior and posterior ends of case similar, slightly convex (Figure 458). The case has erroneously been described as resembling the cases of Agraylea, but the case of Leiochiton fagesii differs from them in the absence of algae in the walls and in its distinct angles at the anterior and posterior margin.

**Pupa.** Length 2.3–3.0 mm; wing sheaths pointed and long. Anterior angles of case with 2 attachment disks, each with a stalk; posterior angles with one disk. The pupae are found on the lower surface of aquatic plants (Figure 458).

Mode of life and habitats. Stagnant water and water bodies with a slow current in plant thickets; common in the Volga delta.

Distribution. European USSR. In addition, Europe.

### 5. Genus **Orthotrichia** Eaton

**Full-grown larva.** Length about 3 mm. Slightly flattened dorsoventrally; not laterally compressed. Sutures of head well marked; frontoclypeus large; setae moderately long; seta 9 strong, longer than the others. Labrum asymmetrical, with a beak-shaped median process on the dorsal sclerite. Mandibles flattened; lower blade of left mandible little developed at the base; 353 median brush of chetoids situated openly. Sides of meso- and metanotum slightly concave; some setae of pronotum and medioanal setae of meso- and metanotum curved anteriorly. Trochantin free, its hornlike process long. Median sternites absent. The difference in length and form of the forelegs and the other legs is not as great as in Agraylea, Hydroptila and Oxyethira; basal process of femur and distal process of tibia hardly marked also on the forelegs; claws of midlegs and hind legs massive, and long, like the tarsi; ventrodistal chetoid of the tarsi leaf-shaped. First abdominal segment with a narrow, transverse rudimentary tergite; abdominal segment 2 with large lateral processes; sclerite of segment 9 oblong, covering the whole segment; anal legs short; claw with 4 setae (2, 3, 7, 8); other setae absent. The case is made of secretion; it is grayish, slightly flattened dorsoventrally; the convex dorsal surface of the case is ribbed, the ventral surface flat.

**Young larva.** Head broad, short; thorax and abdomen tapering posteriorly. Midlegs and hind legs not especially long. Setae of thorax and abdomen moderately long. Section "b" of anal legs cylindrical and long; its intermediate distal seta is the longest seta of the larva; this seta is almost as long as the body in the 1st stage; the lateral seta of section "b" is as long as intermediate seta in the 4th stage. Claw short, with thin and slightly curved end; seta 7 is long, several times as long as the claw. Three caudal tracheal gills.

**Pupa.** Antennae of male pupae longer than those of female pupae. Labrum slightly narrowed, with almost straight anterior margin and convex posterior margin; two pairs of very short setae near the anterior margin; 2 short medial setae and 2 long lateral setae near the posterior margin. Mandibles short, their basal seta straight; seta anterior to it curved. Presegmental plates oblique, oblong; postsegmental plates skittle-shaped and small.

The pupal case is attached to the substrate by single attachment disks connected by flaps of the case; the light color of the flaps contrasts with the dark gray walls of the case.

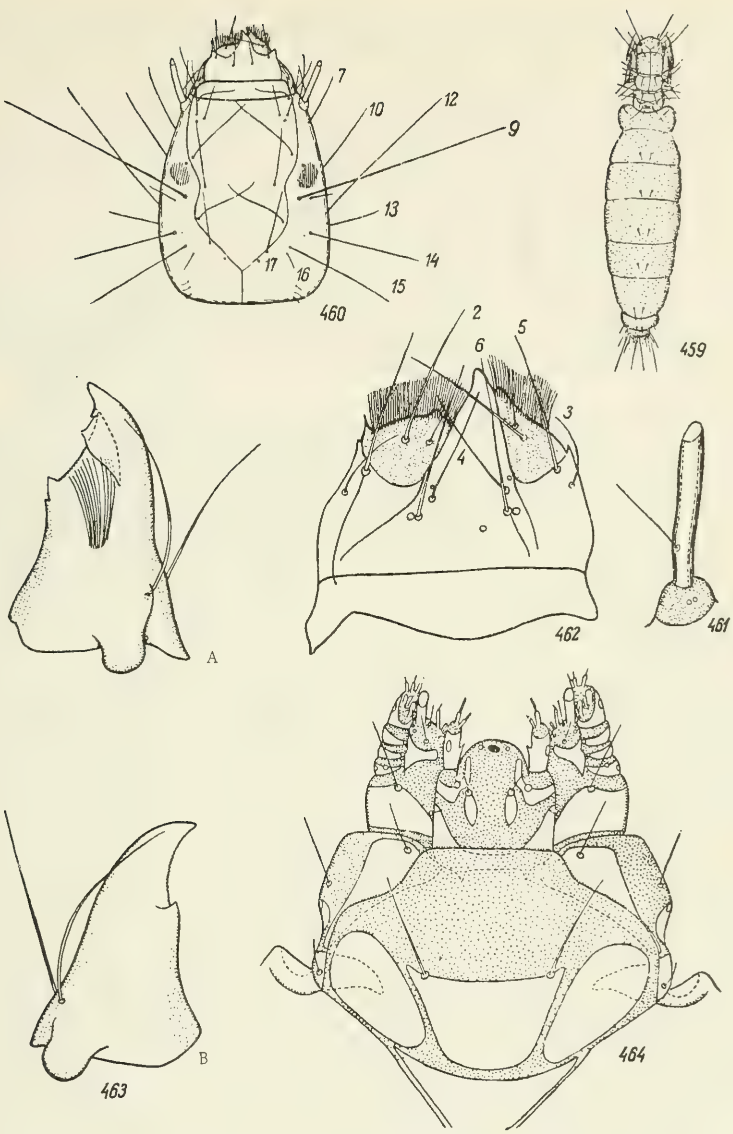
Mode of life and habitats. Stagnant and running water.

Distribution. European USSR. In addition, Europe, Africa, southern Asia, North America.

### 1. **Orthotrichia tetensii** Kolbe

Morton, 1887:202. — Klapálek, 1897:9—11, Figures 3—4. — Struck, 1900:29, Plate 6, Figure 48, Figure 48. — Ulmer, 1903:134; 1909:225, 292, Figure 351, a. — Siltala, 1904b:23—24. — Lestage, 1921:458—464. — Lepneva, 1940:202, —Nielsen, 1948:95—114, 138—139, Figures 2, B, 3, D, 4, D, 34—42, 51, D, 52, C, 63, Plate I, Figures 1—5.

**Full-grown larva.** Length at the end of the stage 2.6—3.1 mm, width of head 0.21—0.24 mm; ratio of length of head, thorax and abdomen at beginning of 5th stage 10:15.5:18.5, at end of stage 10:16.5:77; abdomen not laterally compressed, slightly flattened dorsoventrally (Figure 459). Sclerotized parts brownish yellow, brown or darker in some places. Head (Figure 460) without pattern, uniformly buff yellow, ovoid and narrower anteriorly; in dorsal view head much lower anteriorly than posteriorly; sutures clearly marked. Frontoclypeus relatively large, with long, broad, anterior part; gula with slightly concave broad anterior margin. Sensilla of antennae long ($65\mu$), its seta situated near the base, short and straight (Figure 461). Eyes displaced posteriorly, situated almost in midlength of the head. The setae of the anterior part of the head differ from the normal arrangement of the setae in Orthotrichia; only the lateral inward-curved seta of the 3 anterior-margin setae of the frontoclypeus retains its position near the anterior angle; the other 2 setae and seta 7 are displaced posteriorly and are situated posterior to the antennae; the thin anterior and posterior frontal setae are curved anteriorly and inward, recumbent; setae 8 and 10 retain their position; setae 9 and 11 are both situated posterior to the eye and the curvature of the frontal suture; seta 9 longer and thicker than the others, setae 12, 14 and 15 of about the same length (as long as the width of the head); seta 17 shorter than the above setae, widely separated and directed upward and slightly anteriorly; ventral seta 18 small but well marked.



FIGURES 459–464. Orthotricia tetensii Kolbe (after Nielsen):

459 – full-grown larva, dorsal; 460 – head, dorsal; 461 – right antenna; 462 – labrum; 463 – mandibles, ventral; left mandible (A), right mandible (B); 464 – maxillolabium.

Labrum (Figure 462) oblong, narrower anteriorly, asymmetrical; its dorsal sclerite projects in the middle in form of a long, blunt, beak-shaped process which is slightly curved to the left; posterior angles with short, broad asymmetrical processes; anterior membranous part of labrum also

asymmetrical, with small, sucker-shaped processes; a row of long, straight dark hairlike spines interrupted by the beak-shaped process in the anterior
354 part of the labrum. Setae of labrum yellowish; seta 1 small; setae 3 and 4 thin and curved; seta 2 long, situated on the membranous part; setae 5 and 6 straight, thicker, of about the same length.

Mandibles (Figure 463) flattened; upper blade of left mandible well marked, with 2 basal teeth of different size; the whole other part of the blade finely serrated, as on the mandible of the pupae; lower blade developed only in its distal part and with 2 small teeth; tooth in the middle of the blade little marked; brush situated not in a depression; right mandible with one blade with finely denticulate apical part and large basal tooth; basal setae of mandibles thin and yellowish, of about the same length, situated close together; the seta situated more ventrally is curved, extending along the mandible.

Maxillolabium (Figure 464) short; submentum trapezoidal, with broad, slightly concave anterior margin; setae near the anterior angles moderately long, longer than the other setae; the two ovoid sclerites at the sides of the submentum are the lateral parts of the pregula; the median part of the pregula absent. Seta of cardo thin, short and curved; the stipes consist of a small lateral part and of a larger ventral part; both setae of the stipes are straight and thin, as long as the seta of the maxillary palpifer; sclerites of the first 3 segments of maxillary palps crescent-shaped; 4th segment large; its sclerite with a deep ventral notch and a shallower dorsal notch. The dark sclerite of the mentum projects beneath the membranous fold of the basal part only laterally; ventral sclerites of labial lobes elliptical; sclerites of labial palpiger crescent-shaped; labial palp oblong; one of its two sensillae markedly longer and thicker than the other.

Anterior angles of pronotum (Figure 465) rounded, angles of meso- and metanotum slightly pointed; the main color of the 3 sclerites is brownish yellow; pronotum with a narrow brown stripe near the lateral and posterior margins; a similar stripe near the posterior margin of meso- and metanotum; anterior angles of these sclerites dark brown; metanotum with a very narrow black margin. The number of secondary setae on the thoracic sclerites is given below, in the last column of the table on p. 397. Especially long setae of the pronotum (Figure 465) are the anterior-angle seta which is slightly displaced from the angle and the median anterior-margin seta; the other anterior-margin setae and the secondary anterior-angle seta are much shorter; the second of the 2 lateral setae is very small; the 4 surface setae of the median group are arranged in two pairs situated behind each other; the setae of the lateral group are curved anteriorly. The primary anterior-angle and the primary anterior-margin seta of the meso- and metathorax are larger than the others (Figure 465); the 4 secondary anterior-angle setae are distributed as follows: 2 near the anterior margin and 2 near the lateral margin; the 3 surface setae of the mesonotum are situated in the middle of the sclerite; those of the metanotum are situated closer to the posterior margin: median seta thin and curved, recumbent and directed anteriorly; intermediate and lateral seta situated at a distance, near each other, and of different length.

The horn of the trochantin is long and broad, completely sclerotized; the distal seta forms a strong, thick spine; both setules thin and spinelike; epimeral setae longer (Figure 466). Episternum of meso- and metathorax divided; posterior margin of epimeron almost parallel to the pleural suture; both setae of the pleuron of the meso- and metathorax of almost equal length (Figure 465).

The median anterior sternite of the segments is absent; the lateral posterior sternites form narrow transverse plates; these plates are fused in the middle on the prothorax; they have a narrow median stripe of thickened integument on meso- and metathorax.

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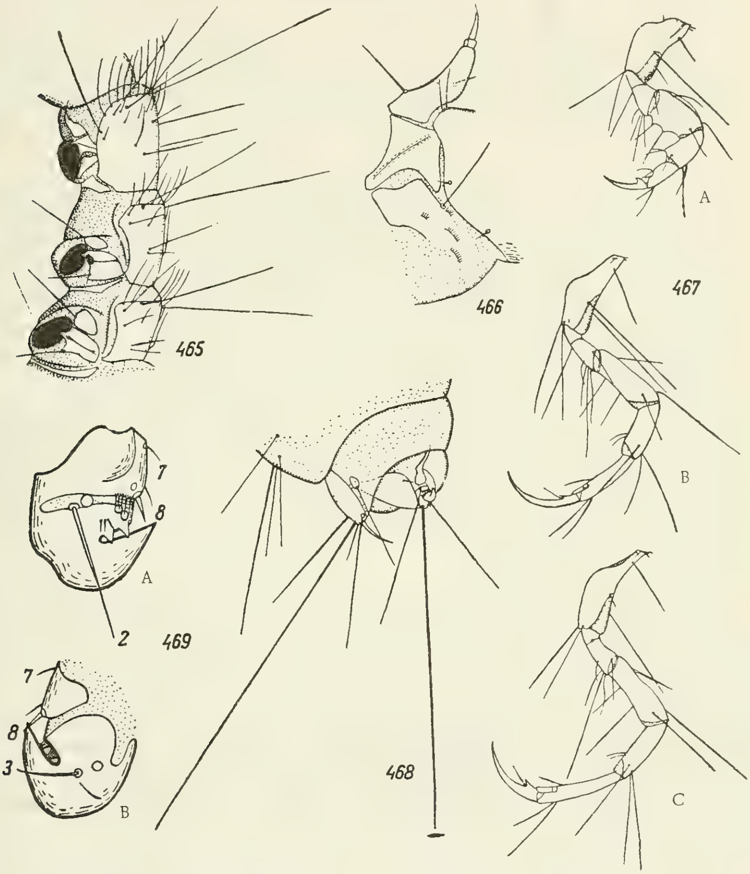


FIGURES 465–469. Orthotrichia tetensii Kolbe (after Nielsen):

465 — thoracic segments, lateral; 466 — pleuron of prothorax; 467 — right legs, posterior: foreleg (A), midleg (B), hind leg (C); 468 — abdominal segments 8 and 9 and anal legs, right side; 469 — claw of right anal leg, outer view (A) and inner view (B).

Legs (Figure 467) less sharply differentiated than in other genera. Basal process of femur and apical process of fore tibia hardly marked. Setae of the legs mainly light. Basal seta of coxa of forelegs forming a large strong spine; anterior distodorsal seta thin; posterodorsal seta long and strong, and is the longest seta of the leg; the basodorsal seta of the femur is curved and shorter than the apical seta; both ventral setae situated basally, on a process, and spinelike; ventral setae of tibia spinelike, short, standing close together on a process in the distal part of the tibia; posterior seta almost twice as long as anterior seta; both dorsal setae of tibia situated subapically; one straight and long, the second short and curved; dorsal setae of tarsus similar, the ventral setae spinelike and light yellow; claw of forelegs longer than the tarsus, with a spinelike basal seta. Midlegs and hind legs with long tarsi and strong massive claws; tarsi of hind legs longer than the femora; mid-tarsi almost as long as the femora. The setae of midlegs and hind legs are shown in Figure 467. The posterior distoventral seta of the tarsi forms a leaf-shaped, long spine. Claws massive, strong, almost as long as the tarsus on the midlegs, slightly shorter on the hind legs; a small short spinule near the base of the basal seta of the claw.

Abdomen broadest in the region of segment 4; segment 1 very short, narrow, as broad as the metathorax; segment 2 with very broad lateral processes; the first abdominal segment dorsally with a narrow rudimentary tergite lateral to which is situated the long median seta and a short inter-
356 mediate anal seta; anterior-angle seta of segment 2 (as in segment 1) is a third as long as the width of the head; both setae situated on small, slightly convex sclerites; similar sclerites are situated in the middle of the dorsum of segments 2—8 near the base of the medioanal setae.

Dorsal sclerites of abdominal segment 9 (Figure 468) overhanging the anal legs like a roof; the medioanal seta is the longest seta of the body; intermediate seta very short and thin; lateral seta forming a light thick, spine curved posteriorly and inward; angle seta of the sclerite straight and strong, as is the anterior-margin seta, which is displaced toward the posterior setae; the short lateroventral seta is situated on the side of the sclerite, on a small sclerite.

357 Sclerite "b" of the anal legs broad, with a thin lateral seta and 3 strong distal setae; one of them situated on the bridge; intermediate distal seta longer and thicker than the others; sclerite "c" oblong, its seta thin. Claw short and massive; the transverse membranous stripe is situated in the basal third (Figure 469); distal part with two short, pointed, spinelike processes at the base; claw with only 5 setae; seta 2 is situated on the outside near the transverse membranous stripe and is moderately long; seta 3 shorter and thinner, situated in the middle; a small groove near it and more dorsally; seta 8 thick and short; setae 5 and 7 shorter and thinner; setae 1, 4 and 6 absent.

The larvae retains the tracheal gills of the young larva at the beginning of the stage; they become rapidly atrophied later.

Case (Figure 475) dark gray, slightly dorsoventrally compressed, 3.4—4.0 mm long; dorsal side of case convex, with five longitudinal ribs, one median and two lateral. The middle of the dorsum of the case of old cases is convex and ribbed, darker than the ventral surface and the ends and forms a hump on the dorsum.

**Young larva.** Length of 1st-stage larva 0.55 mm; width of head in 1st stage 0.11 mm, in 2nd stage 0.13 mm, in 3rd stage 0.16 mm, in 4th stage 0.19 mm, in 5th stage 0.21—0.24 mm; ratio between length of head, thorax and abdomen of freshly hatched larvae 10:16.5:21.5. The head of the 1st stage is slightly wider than long; prothorax as broad as the head; the following thoracic and abdominal segments taper gradually posteriorly (Figure 470); the relative width of meso- and metanotum and of the abdominal segments becomes larger in the later stages and the form of the larva changes. The setae on the body (except the setae of the anal legs) are moderately long. The gradual development of the secondary setae on the dorsum of the thorax is given in Table 7.

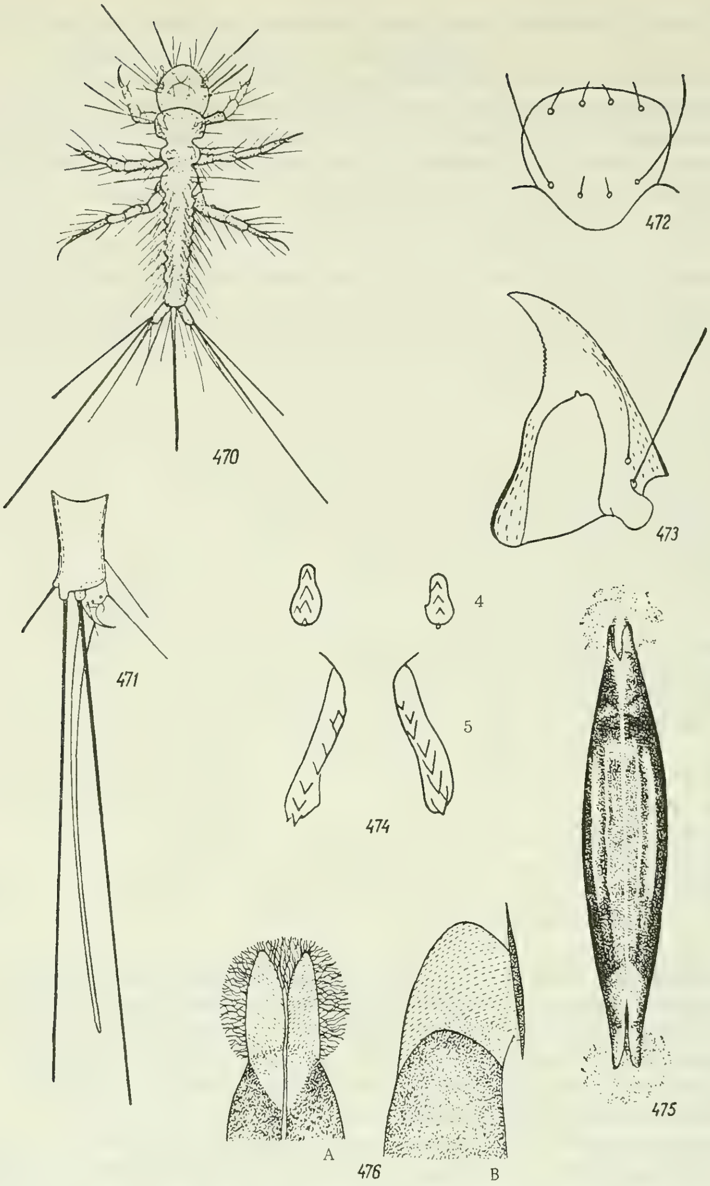
TABLE 7

| Setae | Stage | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th |
| Pronotum | | | | | |
| Anterior-angle setae ............... | 1 | 1 | 2 | 2 | 2 |
| Straight, dark, anterior-margin setae.. | 0 | 2 | 2 | 2 | 2 |
| Curved, yellow, anterior-margin setae | 0 | 0 | 5 | 8 | 8–9 |
| Marginal lateral setae ............. | 0 | 0 | 1 | 2 | 2 |
| Secondary surface setae ............ | 0 | 1 | 2 | 3–5 | 5–8 |
| Mesonotum | | | | | |
| Anterior-angle setae .............. | 1 | 1 | 2 | 4 | 5 |
| Median anterior-margin setae ...... | 0 | 0 | 1 | 2 (–3) | 2 (–3) |
| Lateral anterior-margin setae ....... | 0 | 0 | 2 | 2 | 2 |
| Secondary surface setae ........... | 0 | 0 | 0 | 0 | 2 |
| Metanotum | | | | | |
| Anterior-angle setae ............. | 1 | 1 | 2 | 4 (–5) | 5 |
| Median anterior-margin setae ...... | 0 | 0 | 1 | 1 (–2) | 1 (–2) |
| Lateral anterior-margin setae ....... | 0 | 0 | 2 | 2 | 2 |
| Secondary surface setae ........... | 0 | 0 | 0 | 0 | 2–3 |

The setae of the trochantin of the early stages are longer and thinner than in the full-grown larva. The difference between the length of the forelegs and the other legs of young larvae is not as large as in species of Agraylea, Hydroptila and Oxyethira; basal seta of the claw absent in the early stages, the ventrodistal, leaf-shaped seta of the tarsus is already present in the 4th stage.

As in other genera of Hydroptilidae, abdominal segments 1—8 bear tergites covering only part of the dorsum; sclerite of abdominal segment 9 well developed. Setae of abdomen of young larvae moderately long; anterior-angle and medioanal setae longer and thicker than the others; they are situated on small processes in the 3rd and 4th stages; the processes
359 at the base of the angle setae gradually decrease in size posteriorly; they are absent on segment 8.

Section "b" of anal legs (Figure 471) long, twice as long as broad; intermediate and lateral distal setae long and thick; median and ventral setae of



FIGURES 470–476. Orthotrichia tetensii Kolbe (after Nielsen):

470 – 1st-stage larva; 471 – right anal leg of 4th-stage larva, outer view; 472 – labrum of pupa; 473 – left mandible of pupa, ventral; 474 – sclerites of holding apparatus: postsegmental plates of segment 4 and presegmental plates of segment 5; 475 – larval case, dorsal; 476 – posterior end of pupal case, dorsal (A) and lateral (B).

normal length. Claw (Figure 471) short; the basal section is separated by a transverse stripe, which is massive and broad; end of claw thin and strongly curved. Seta 8 on the claw thin and curved in the early stages; seta 7 long, as long as the ventral seta of the basal part. The young larvae have three caudal tracheal gills; gills of live specimens silver-colored; median gill situated on the posterior margin of the dorsum; lateral gills on the distal end of the basal part of the anal legs (Figures 470 and 471).

**Pupa.** Length of male pupae 2.7 mm, of female pupae 2.9 mm; antennae of male pupae reaching middle of segment 7; antennae of female pupae reaching posterior margin of segment 3; the pointed wing sheaths reach the posterior end of the body in both sexes. Labrum with slightly convex, almost straight anterior margin (Figure 472) and with two pairs of short setae; 2 short median setae and 2 long lateral setae near the posterior margin. Mandibles short and massive (Figure 473); their distal part serrated; the straight basal seta is situated near the base; seta anterior to it short and curved. The natatorial setae are situated dorsally and ventrally on segments 1 and 2 of the mid-tarsi. Presegmental plates (Figure 474) oblong, oblique; postsegmental plates shorter and pear-shaped; both types of plates with a longitudinal row of spines. Number of spines: III:6—9 + 2—5; IV:7—9 + 2—5; V:6—9 + 2—4; VI:7—13; VII:7—12; the difference in the size of the spines is smaller than in the preceding genera.

Pupal case slightly prolonged at both sides with thin, light plates woven by the larva at the anterior and posterior end; dorsal sides of plates contiguous in the middle (Figure 476); ventral sides of the plates diverging and fused with the disk attached to the substrate (the disk consists of thin, radial filaments); ends of case closed with a thin membrane.

Mode of life and habitats. Lakes and slowly running rivers in the plains; in plant thickets.

Distribution. European USSR. In addition, Europe, Iran, recorded in Africa.

## 6. Genus **Ithytrichia** Eaton

**Full-grown larva.** Length about 3 mm. Head slightly flattened dorsoventrally, narrower anteriorly; frontoclypeus large; gula fused with the pregula. Eyes situated at midlength of head; sensilla of antenna long, with a seta at the base. Posterior frontal setae long, curved to the surface of the sclerite; seta 9 longer than the others; setae 17 widely separated.

Labrum oblong, without a median notch on the membranous margin. Mandibles flattened; right mandible without a lower blade; left mandible with a rudimentary lower blade in the distal part.

Nota of thorax with numerous short, soft secondary surface setae in the anterior half. Horn of trochantin long. Prothorax with two fused posterior sternites; meso- and metathorax with one median sternite. Forelegs without basal process of femur and without apical process of tibia; midlegs and hind legs with long tarsi and massive claws. Abdomen laterally compressed; abdominal segment 2 with lateral processes; segments 3—6 with dorsal and ventral sucker-shaped appendages; a similar appendage also on the dorsum of segment 7; segment 9 with a median tracheal gill. Anal legs conical and broad; claws short. Case sac-shaped, broad, dorsoventrally compressed, with a round anterior opening and a slitlike posterior opening.

**Young larva.** Head broader than long; body tapering posteriorly. Difference in length of legs smaller than in the full-grown larva. Dorsum of abdominal segments 1–8 with transverse tergites; dorsal and ventral processes of abdomen absent; segment 9 completely sclerotized, with a median tracheal gill. Anal legs long; their claws are thin, without tracheal gills.

**Pupa.** Antennae short, reaching abdominal segments 2–4. Labrum with one pair of setae near the anterior margin and two pairs of setae near the posterior margin. Natatorial setae present on segments 1 and 2 of the midtarsi. Presegmental plates elliptical; postsegmental plates rounded.

Mode of life and habitats. Plant thickets in water bodies with a slow current.

Distribution. Northwest, west and central belt of the European USSR. In addition, Europe, North America, recorded in India.

360 1. **Ithytrichia lamellaris** Eaton

Morton, 1888a:171–173. — Klapálek, 1897:6–9. — Richters, 1902:19–21. — Ulmer, 1902a:360–366; 1903:134; 1909:134, 223, 293, Figure 349. — Lundblad, 1918, 39:342–343. — Lauterborn and Rimsky-Korsakow, 1903:280–288, Figures 1–6. — Siltala, 1904b:20–22. — Lestage, 1921:450–452, Figures 144–145. — Lepneva, 1940:202. — Nielsen, 1948:114–132, 139–140, Figures 3, E, 4, E, 6, E, K, 7, H, I, K, L, 43–50, 52, D, Plate II, Figures 6–22, Plate III, Figure 27, 28.

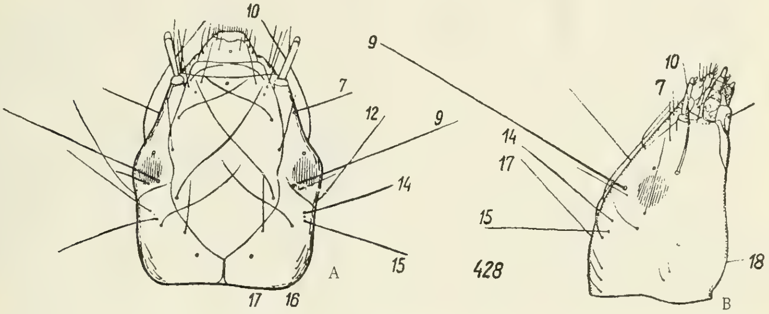
**Full-grown larva.** Length at beginning of 5th stage 1.05 mm, at end of 5th stage 0.3 mm; ratio of length of head, thorax and abdomen at beginning of stage 10:35.5:12.5, at end of stage 10:14.5:82. A remarkable character is the presence of sucker-shaped, dorsal and ventral appendages on the abdominal segments (Figure 477).

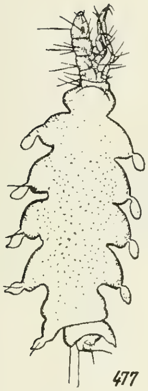
Head (Figure 478) broad in the middle, slightly dorsoventrally compressed (ratio of height to width 0.72), narrower anteriorly; frontoclypeus large, broad; coronal suture of head even shorter than in Orthotrichia; gula fused with pregula, its posterior angle blunt. Eyes situated at about midlength of head; sensillae of antennae long, directed forward (Figure 479); a seta at the base of the sensilla. Setae on head light; the 3 anterior-margin setae situated in the angles of the sclerite; intermediate anterior-margin seta and anterior and posterior frontal setae curved, recumbent toward the middle, like seta 16 and the small seta 13; seta 9 much longer than the others; near it the thin short seta 11; seta 10 curved anteriorly, thick, relatively long; setae 7 and 8 straight and short; setae 12, 14 and 15 thin, about the same length; setae 17 slightly shorter; seta 18 spinelike.

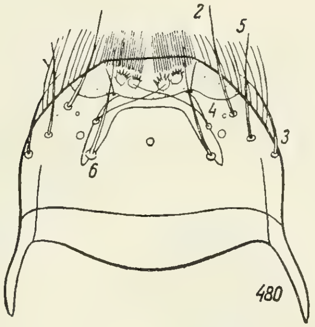
Labrum (Figure 480) narrower anteriorly; membranous anterior margin of labrum rounded laterally, straight in the middle, without median notch; anterior angles not marked; median notch of dorsal sclerite shallow; a horseshoe-shaped thickening near the anterior margin of the sclerite; posterior-angle sclerites long, slightly curved, slightly asymmetrical.

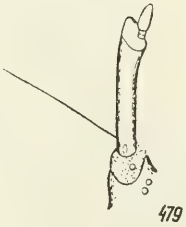
Setae of labrum thin, light; the small seta 1 is situated near the margin of the dorsal sclerite on each side of the median notch; all other setae situated on surface; setae 3 and 4 are curved inward; setae 2, 5 and 6 of equal length; a row of hairs, which are denser in the middle near the anterior margin; two flat chetoids with several pointed apical spinules near the base of the median part of the row on each side.

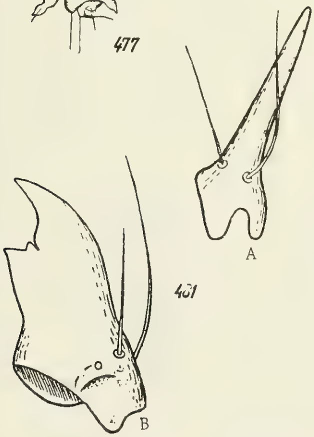
(361)

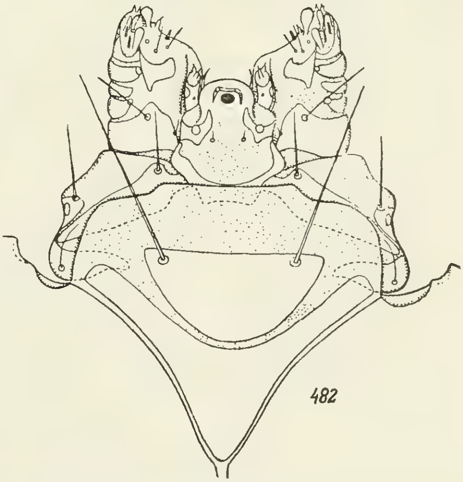












FIGURES 477–482. Ithytrichia lamellaris Eat. (after Nielsen):

477 – full-grown larva, lateral; 478 – head, dorsal (A) and lateral (B); 479 – right antenna; 480 – labrum; 481 – right mandible, outer view (A), dorsal (B); 482 – gula and maxillolabium.

Mandibles (Figure 481) more flattened than in Orthotrichia; distal part of lower blade on the left mandible very short and without teeth; the serrated upper blade of the left mandible with a small basal tooth; brush of chetoids short and situated in the anterior third of the mandible; upper blade of right mandible with a deep rounded notch and with 2 basal teeth near the distal margin; basal setae yellow; seta situated more ventrally curved; second seta straight, shorter and thinner. Maxillolabium (Figure 482) with a broad basal part; submentum rounded posteriorly, with straight anterior margin; its angle setae strong, light, moderately long; cardo with a thin, small, curved seta; setae of stipes short and straight; the distal seta of the palpiger is longer and thinner; median seta small. Sclerites of segments 1—3 of the maxillary palps open and short; sclerite of 4th segment with a deep dorsal and ventral notch at the distal margin (as in Orthotrichia). Sensilla of group I at the apex of the galea, short and thin, its apex pear-shaped; setae of galea straight, short and spinelike.

Pronotum (Figure 483) markedly less convex than in Orthotrichia, slightly narrower in the middle; both anterior-angle setae (primary and secondary) long, the lateral setae slightly shorter and curved; dark secondary anterior-margin setae short ($^1/_3$ of the width of the head), slightly longer than the curved yellow setae; anterior half of sclerite covered with thin, small, anteriorly curved hairlike setae; primary surface setae in the middle of the sclerite, which stand in pairs behind each other.

The primary angle seta of meso- and metathorax is as long as on the prothorax; 2 of the 4 secondary angle setae are situated near the anterior margin and 2 posterior to the primary seta; anterior-margin setae short; intermediate and lateral primary surface setae situated close together; hairlike setae (like those on the pronotum) present but in smaller numbers.

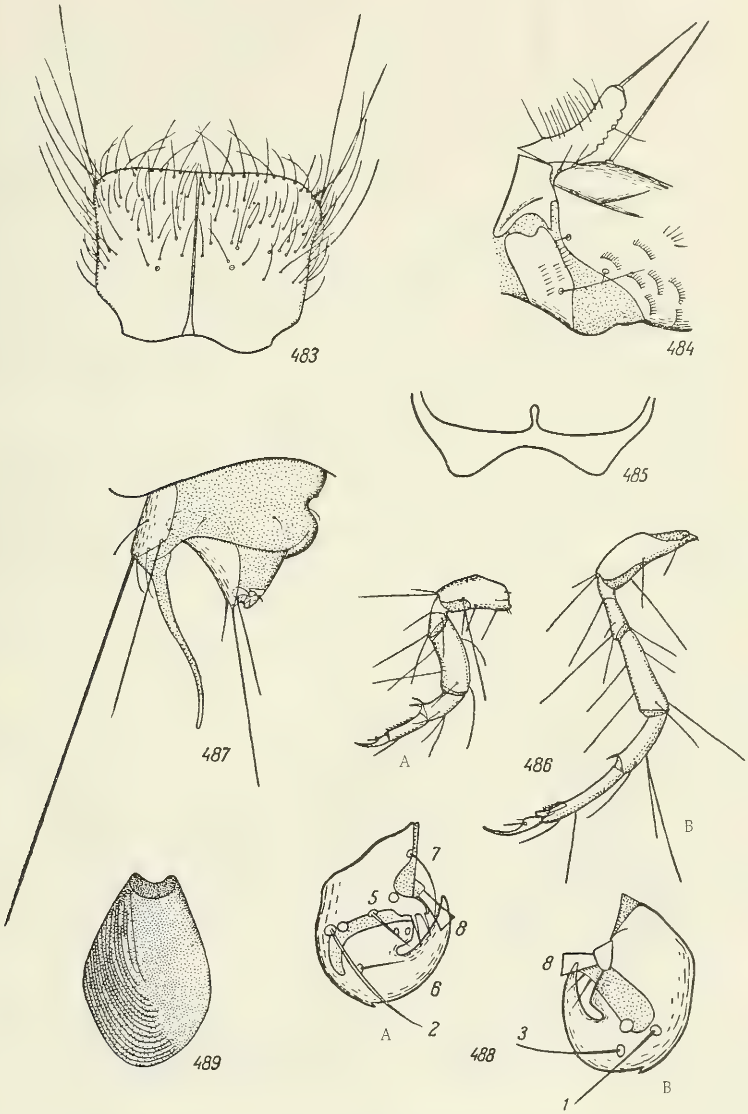
Hornlike process of trochantin completely sclerotized, rugose on the ventral side (Figure 484); in addition to the distal primary seta and 2 setules, there are short, thin chetoids at the anterior margin of the horn; transverse membranous stripe of epimeron broad in the middle; seta moderately long; episternum of meso- and metathorax is complete; setae
362 of episternum of these segments and of epimeron of mesothorax as long as the anterior-angle seta; seta of epimeron of metathorax half as long.

Posterior sternite of prothorax (Figure 485) as in Orthotrichia; median sternite of mesothorax rectangular; that of the metathorax square; the sculpture of the sternites of Oxyethira is absent in Ithytrichia.

Legs (Figure 486) relatively short; ratio of length of 1st-, 2nd- and 3rd pair 72:100:117.

The basal seta of the coxa of the foreleg forms a yellow spine; posterodorsal seta longer than the others; basal process of femur absent; ventral setae of femur equally long, situated in the apical and basal thirds of the segment; apical process on tibia of forelegs absent; anteroventral seta of tibia forming a lanceolate spine; the posteroventral seta a strong hooklike spine; tarsus ventrally with a row of short, dense spinules; ventrodistal setae of tarsus yellow and spinelike; claw with a spinule at the base of the basal seta. Basal seta of coxa of midleg pale, curved; it is a straight yellow spine on the hind legs; both other dorsal setae of the coxa of the midlegs and the anterodorsal seta of the coxa of the hind legs are long; One of the distoventral setae of the trochanter, the distodorsal seta of the femur and the posterior distodorsal seta of the tibia very long; the ventrodistal setae of the tibia are spinelike; posterior seta of tibiae displaced toward the dorsal setae, curved to the distal end. Tarsi of midlegs and hind legs long; tarsi distally with a leaf-shaped chetoid and short pale, setae on the ventral side (as in Orthotrichia); distodorsal seta of tarsus curved; subapical seta straight. Spinule at the base of the seta of the claw slightly longer than on the forelegs.

(363)



FIGURES 483–489. Ithytrichia lamellaris Eat. (after Nielsen):

483 – pronotum; 484 – pleuron of prothorax and base of coxa of foreleg; 485 – prosternum; 486 – right legs, posterior: foreleg (A) and hind leg (B); 487 – abdominal segment 9 and right anal leg, outer view; 488 – claw of right anal leg, outer view (A) and inner view (B); 489 – larval case.

Abdominal segment small, only slightly broader than metathorax. Segment 2 with large lateral processes; the strongly convex dorsal side of segments 3–7 and the ventral side of segments 3–6 with characteristic single ovoid processes; ventral processes separated from segment by deep constrictions; dorsal processes separated by less deep constrictions; abdominal segment 7 slightly convex ventrally; segment 8 prolonged into a long process which is not separated from the segment by a constriction. Dorsal part of segment 9 covered by a sclerite which projects like a roof above the anal legs, covering the base of the single tracheal gill (Figure 487).

Medioanal and angle setae of abdomen not longer than half the width of the head on segments 1–5; they are longer on the posterior segments (they are 1.25 times as long as the width of the head on segment 8); ventrolateral seta on segments 1–7 clearly marked. Medioanal seta of sclerite of segment 9 longer than the others (1.66 times as long as the width of the head); angle seta almost half as long; intermediate lateral seta and the anterior-margin setae short and curved.

Section "b" of the anal legs (Figure 487) broad; dorsolateral sclerites of both sides contiguous in the middle; distal intermediate seta longer than the others; seta of sclerite "c" small. Claw (Figure 488) very small; its transverse membranous stripe broad; its distal part strongly curved; basal part with two pointed spinules directed to the end of the claw; setae 1, 2 and 3 longer than the others; seta 4 absent; setae 5 and 6 short, spinelike; seta 7 curved; seta 8 forms a trapezoidal plate.

Case of full-grown larva made of secretion, resembling a pumpkin seed (Figure 489); anterior end of the case narrower, ending in a rounded opening; a broad slit flanked with flaps in the posterior part; these flaps are contiguous in their greater part; they are separated by a small opening only in the middle. The larva lies in its case so that the broad surfaces form the dorsal and ventral sides of the case; the ventral side of the case is more convex. The lower side is directed toward the substrate and pressed to the substrate by contraction of the abdominal musculature; the larva lives in brooks and rivulets; its adaptation to running water resembles that of other flattened rheophilic animals.

**Young larva.** Length in 2nd stage 0.70 mm; width of head in 2nd stage 0.13 mm, in 3rd stage 0.17 mm, in 4th stage 0.23 mm, in 5th stage 0.27–0.33 mm. Head of young larvae broad; its anterior part is not yet developed. The thoracic segments decrease in width posteriorly; development of secondary setae of thorax is shown in Table 8.

Anterior-angle setae of thorax longer than the other; medioanal setae curved posteriorly. Distal seta of trochantin of young larvae situated not at the end of the sclerite but slightly laterally. Ratio of length of legs of young larva 80:100:115.

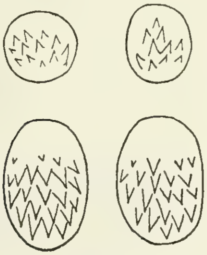
Abdominal segments 1–8 with small single tergites in the posterior half; segment 1 with a small transverse tergite anterior to the posterior tergite; abdominal segment 9 completely sclerotized; its posterior part with a median tracheal gill. Anal gills long (as in Orthotrichia); claws without tracheal gills.

364 **Pupa.** Length 2.7–3.1 mm. Antennae short, reaching anterior margin of segment 4 in male pupae, middle of segment 2 in female pupae. One pair of setae near the anterior margin of the labrum; two pairs of setae

near the posterior margin. Basal seta of mandible straight; seta anterior to it curved. The pointed wing sheaths of male pupae reach almost the end of the abdomen; those of the female pupae are slightly longer; natatorial setae of segments 1 and 2 of the mid-tarsi dense.

TABLE 8

| Setae | Stage | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th |
| Pronotum | | | | | |
| Anterior-angle setae | 1 | 1 | 2 | 2 | 2 |
| Straight anterior-margin setae | 0 | 3 | 3 | 3 | 3 |
| Curved anterior-margin setae | 0 | 0 | 4–5 | 8 | 11–12 |
| Lateral marginal setae | 0 | 0 | 1 | 1 | 2 |
| Surface setae | 4 | 4 | 4 | 13–16 | 35–45 |
| Mesonotum | | | | | |
| Anterior-angle setae | 1 | 1 | 3 | 5 | 5 |
| Median anterior-margin setae | 0 | 0 | 1 | 3 | 4 |
| Lateral anterior-margin setae | 0 | 0 | 1 | 1 | 2 (–3) |
| Surface setae | 3 | 3 | 3 | 7 | 23–30 |
| Metanotum | | | | | |
| Anterior-angle setae | 1 | 1 | 3 | 5 | 5 |
| Median anterior-margin setae | 0 | 0 | 1 | 2 | 2 (–3) |
| Lateral anterior-margin setae | 0 | 0 | 1 | 1 | 3 |
| Surface setae | 3 | 3 | 3 | 7 | 20–28 |



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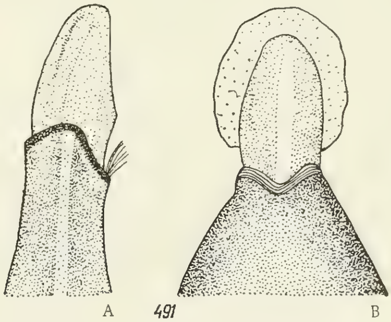

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FIGURES 490 and 491. Ithytrichia lamellaris Eat. (after Nielsen):

490 – sclerites of holding apparatus of pupa: postsegmental plates of segment 4 and presegmental plates of segment 5; 491 – anterior end of pupal case, lateral (A) and dorsal (B).

Presegmental plates broadly oval, slightly oblong; postsegmental plates rounded; number of spines on these plates as follows: III:11–16+ 7–15; IV:15–19+ 9–15; V:19–21+ 9–15; VI:15–23; VII:17–20; the plates bear large spines and several small spinules (Figure 490).

365 The pupal case is a slightly modified larval case directed to the substrate with its broad ventral side; it has posteriorly a median single ligament which is broadened into a small attachment disk at the end; the pupal case is prolonged anteriorly (Figure 491) into a fingerlike, slightly curved tube; this tube opens on the wide attachment disk of the anterior end.

Mode of life and habitats. Running water, brooks and rivulets in plant thickets.

Distribution. Northwest, west and central belt of the European USSR. In addition, Europe.

## 7. Genus **Stactobia** McLachlan

**Full-grown larva.** Small larvae with dark sclerites. Sensilla of antennae long, with a seta near the apex; labrum slightly oblong. Legs relatively short, differing little in length; claws long, almost as long as the tarsus. Abdominal segments with dark, transverse tergites.

Case irregularly barrel-shaped, more convex dorsally, made of secretion with a few fine sand grains.

**Pupa.** Length about 2 mm. Antennae short, not reaching beyond the anterior segments of the abdomen. Labrum short; median process of anterior margin of labrum blunt. Mandibles with smooth blades without serration. Wing sheaths pointed, reaching the end of the body or slightly beyond it. Holding apparatus present on abdominal segments 3—7.

Anterior and posterior end of pupal case attached by medially situated disks.

Mode of life and habitats. Small running water bodies, often springs.

Distribution. European USSR, Middle Asia. In addition, Europe.

### Key to Species

Full-grown larva

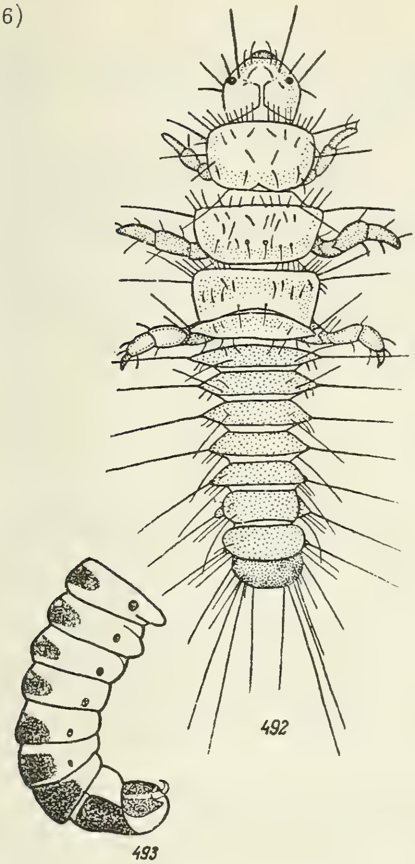
1 (2). Dorsal side of case only slightly more convex than ventral side; case completely covered with a thin layer of fine sand grains . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **1. S. eatoniella** McL. (p. 406)

2 (1). Dorsal side of case markedly more convex than ventral side, with three longitudinal ribs; ventral side of case without sand grains . . . . . . . . . . . . . . . . . . . . . . . . . . . **2. S. fuscicornis** Scheider (p. 408)

### 1. **Stactobia eatoniella** McLachlan

Klapálek, 1901:73—76, Figures 3—11.— Ulmer, 1903:136; 1909:223, 292.— Thienemann, 1904b:261, Figure 19.— Lestage, 1921:452—455.

**Full-grown larva.** Larvae small, 2.2—2.5 mm long; sclerotized parts dark. Head oblong, slightly narrower anteriorly, blackish brown; eyes situated on a light area; sensilla of antennae long, with a seta near the apex. Labrum longer than broad; hairs near the anterior margin long laterally and short in the middle. Mandibles asymmetrical; left mandible longer than right, with 2 blunt distal teeth, and with a deep groovelike median notch; (366) blades serrated; upper blade with a large blunt, broad tooth; right mandible slightly concave on the inner side, with a large distal tooth and 2 teeth lateral to it; outer basal setae of mandible of different length. Submentum very broad.



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FIGURES 492 and 493. Stactobia fuscicornis Schneider (after Siltala):

492 – 3rd-stage larva, dorsal; 493 – abdomen of 4th-stage larva, lateral.

Sclerites of thorax blackish brown, narrower posteriorly, with dark setae. Legs relatively short and strong, blackish brown; claws almost as long as tarsi, with a straight basal spine.

Abdominal segment 1 almost as broad as metathorax; segments 4 and 5 broader and higher than the others. Abdominal tergites blackish brown or blackish; sclerite of abdominal segment 1 curved, lighter posteriorly than anteriorly; sclerites of segments 2–7 broader in the middle than laterally, rounded posteriorly; sclerite of segment 8 larger than on the preceding segments; surface setae situated near the posterior margin of the sclerites; small conical tubercles with a sclerotized dot and 2 lateral setae at the apex on the sides of the segments. Intersegmental constrictions with small dark rodlike sclerites. Sclerite of segment 9 covering the dorsum completely. Claws of anal legs short and strong.

Case barrel-shaped, grayish yellow, slightly dorsoventrally compressed, made of secretion and with fine sand grains; anterior and posterior openings oblique; length of case 3 mm, width 0.7–0.8 mm.

**Pupa.** Length 1.7–2.1 mm. Head broad, antennae short, reaching anterior segments of abdomen. Labrum with a blunt median process at the anterior margin; lateral setae at posterior margin long. Mandibles slightly curved, gradually tapering from the broad base to the narrow apex, with smooth, nonserrated blades; basal outer setae short, situated behind each other. Wing sheaths reaching end of body or slightly beyond it. First tarsal segment very long. Presegmental plates light, situated on segments 3–7; postsegmental plates darker, situated on segments 3–5.

Mode of life and habitats. Springs and brooks, in humid moss.

Distribution. USSR: not recorded, possibly occurring in the west and southwest. In addition, Europe.

### 2. Stactobia fuscicornis Schneider

Lauterborn, 1904:129. — Thienemann, 1905b:553—555, Figure 110. — Ulmer, 1906:295. — Siltala, 1907:390—393, Plate 14, Figure 3, h, i, m. — Ulmer, 1909:223, 292. — Vaillant, 1951b:205—208, Figures 2, 7, 11.

**Full-grown larva** (Figures 492 and 493). Length 3 mm. Closely resembling S. eatoniella, differing in that the dorsal and ventral sides of the case are more sharply differentiated. Dorsal side more convex than in S. eatoniella, with 3 little marked longitudinal ribs.

Mode of life and habitats. Springs, small brooks, on humid rocks.

Distribution. USSR: not recorded, possibly occurring in the west and southwest. In addition, Europe.

## IV. Family PHILOPOTAMIDAE Stephens

**Full-grown larva.** Length 7.5—22.0 mm; body long, uniformly narrow; intersegmental constrictions deep. Head narrow, dorsoventrally compressed; head and prothorax narrower than the following segments of thorax and abdomen, without pattern or with indistinct dots. Frontoclypeus oblong, with shallow lateral indentations and broad, projecting anterior margin; coronal suture short; gular suture long; gula short, broadly triangular. Eyes small, divided, situated on a light area in the anterior quarter of the head; antennae forming a small tubercle near base of mandibles, with 2 sensillae and 3 setae. Setae of head short, some of them spinelike or setuliform.

Labrum trapezoidal, narrower posteriorly, with movable lateral lobes, 367 membranous in its greater part, transparent whitish; a small dorsal sclerite in the middle at the base; setae short; labrum retractile under the clypeus; if the labrum is retracted, the lateral lobes are bent ventrally. Mandibles with curved outer margin and long beak-shaped apex; upper blade reduced, with 1 or 2 apical teeth; lower blade with apical and basal teeth and a small serrated part between them; transverse groove and median brush absent; outer setae equally long, situated at a distance from the basal margin; anterior seta curved. Maxillolabium oblong; submentum trapezoidal, its setae and distal setae of cardo and palpifer longer and thicker than the other setae; stipes narrow, oblique, sometimes with a dark longitudinal stripe; galea with 3 groups of dense hairs, which form a fan or a brush; maxillary palps straight or slightly concave; the 3rd segment the longest; sclerites ring-shaped; mentum very broad, longer than submentum; labium simple and blunt.

Pronotum convex, narrower posteriorly; posterior margin broadly black; lateral margin also partly black; anterior angle of sclerite forming almost a right angle; posterior angle not prolonged. Meso- and metathorax membranous, longer and broader than prothorax. Episternum and epimeron of propleuron almost of the same size; trochantin oblong, with a more or less distinct horn-shaped process. Meso- and metapleural sclerites small; episternum larger than epimeron.

Legs short and weak; midlegs slightly longer than the others; setae of legs short, many of them spinelike; claws with an outer spine near the seta.

Abdominal segment 9 much narrower than the preceding segments, without dorsal sclerite; anal legs long; anus forming a transverse slit; five anal gills below the dorsal fold, which covers the anus and the base of the anal legs.

Most abdominal setae small and light, like setules; ventral setae of segment 9 situated on small sclerites. Sclerite "a" of anal legs soft and well marked; sclerite "b" oblong; its 2 distal setae longer than the others; seta of sclerite "c" small; claw strong and short, without basal or dorsal denticles; all 8 setae present.

**Pupa.** Male pupae 5—10 mm long, female pupae 6—12 mm; antennae shorter than body, reaching segment 3 in male pupae and segments 5—7 in female pupae; first segment with 2—4 dark setae; eyes large. Labrum short and semicircular, with 3 setae laterally at the anterior margin. Mandibles strong and long, geniculate at the base; blade serrated, with 3 large teeth; outer setae short, anterior seta shorter than posterior seta and curved; mandibles of pupa folded at rest and their ends project laterally. Wing sheaths short, reaching segments 3—4, pointed; posterior wing sheaths longer than anterior sheaths. Natatorial setae of mid-tarsi thin, dark; dorsal row present on segments 1—3, ventral row on segments 1 and 2; a few setae also on the 3rd segment; claws of fore and mid-tarsi curved, dark and strong; claws of hind tarsi weak and almost straight.

Presegmental plates of holding apparatus present on segments 3—7; postsegmental plates on segment 5; plates and spinules yellowish; each plate with 8 or 9 spinules; spinules on presegmental plates situated in the middle of the plates, near the posterior margin on postsegmental plates. Anal lobes absent; end of body of female pupa conical, blunt; male genitalia distinct, i. e., lower appendages and sheath of penis.

Pupal case oblong, elliptical, with a covering of small stones or sand grains, 10—18 mm long; pupa lying in a thick gray cocoon which is attached in many points to the wall of the case.

Mode of life and habitats. Cool running water and stony bottom; larvae and pupae on the underside of stones; eyes therefore small and the very sensitive and movable labrum membranous; some species occur in caves.

Distribution. USSR: European and Asian parts, mainly in mountainous regions; cosmopolitan.

### Key to Genera

Full-grown larva

1 (2). Anterior margin of frontoclypeus with a deep asymmetrical indentation; coxa of forelegs distodorsally with a large long spinelike process near the strong anterior seta . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **4. Chimarrha** Steph. (p. 421)

368 2 (1). Indentation of anterior margin of frontoclypeus small or absent; coxa of forelegs of different form.

3 (4). Larvae medium-sized, 14–15 mm long; outer margin of mandibles not straight, crenulated; trochantin of prothorax with a short distal process; Caucasus and Asian parts of the USSR . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. **Dolophilodes** Ulm. (p. 419)

4 (3). Larvae small (8–13 mm) or longer (20–22 mm); outer margin of mandibles straight; trochantin of prothorax with a longer horn-shaped process; Caucasus and European USSR.

5 (6). Length 8–13 mm; anterior margin of frontoclypeus without indentation, symmetrically rounded; median margin of left mandible slightly concave; outer setae of mandibles situated close together at the base; apical seta curved . . . . . . . . 1. **Wormaldia** McL. (p. 410)

6 (5). Larvae large, 20–22 mm long; anterior margin of frontoclypeus with a shallow asymmetrical indentation; blades of mandibles almost straight or slightly curved; outer setae of mandibles more widely separated . . . . . . . . . . . . . . . . . 2. **Philopotamus** Steph. (p. 417)

Pupa

1 (2). Mandibles with a large subapical, divided tooth; number of spurs 1, 4, 4; presegmental plates of holding apparatus present on segments 3–8 . . . . . . . . . . . . . . . . . . 4. **Chimarra** Steph. (p. 421)

2 (1). Mandibles with 3 subapical teeth in addition to the apical tooth; number of spurs 2, 4, 4; presegmental plates present on segments 3–7.

3 (4). Length 5–8 mm. Presegmental plates of abdominal segment 6 with a large curved, pointed hook; walls of case loose, with a covering of sand grains; length of case 8–13 mm . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Wormaldia** McL. (p. 410)

4 (3). Length 11–14 mm; presegmental plates of abdominal segment 6 with 6–9 hooks; case oblong-elliptical, 19–20 mm long; walls of case consisting of small stones . . . . . . . . 2. **Philopotamus** Steph. (p. 417)

### 1. Genus **Wormaldia** McLachlan

**Full-grown larva.** Larvae small, at beginning of last stage about 8 mm long, at end of stage about 10–13 mm. Head yellow or reddish yellow, with indistinct dark spots. Anterior margin of frontoclypeus rounded and symmetrical. Inner margin of mandibles concave distally, convex in the middle; outer setae almost equally long, situated close together; anterior seta curved, recumbent. Pronotum and head light, with indistinct dots. Trochantin with a fingerlike process. Legs light and without dots; basal part of claws of legs distinctly shorter than apical part; forelegs slightly thicker and darker than the others. Abdominal segments (except segment 9) almost uniformly broad; sclerite of anal legs with indistinct dots.

Key to Species

Full-grown larva

1 (2). Length at end of 5th stage about 13 mm; lateral margin of pronotum with a brown stripe near the pleural articulation, and without black spot . . . . . . . . . . . . . . . . . . . . . . . 1. **W. occipitalis** Pict. (p. 411)

2 (1). Length at end of 5th stage about 10 mm; lateral margin of pronotum with a large black spot near the pleural articulation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **W. subnigra** McL. (p. 415)

Pupa

1 (2). Length of male pupae 5.7–6.5 mm, length of female pupae 6.7–7.7 mm; all 3 setae of labrum small and light, thick; lower appendages of male genitalia shorter than penis . . . . . . . 1. **W. occipitalis** Pict. (p. 411)

2 (1). Length of male pupae 5–6 mm, of female pupae 6.5–7.0 mm; 2 anterior setae of labrum small, thin and light; seta posterior to them much longer and dark; lower appendages of male genitalia longer than penis . . . . . . . . . . . . . . . . 2. **W. subnigra** McL. (p. 415)

### 369 1. **Wormaldia occipitalis** Pictet

Nielsen, 1942:374–395, Figures 2, 36–49. – Brindle, 1960a:144–147.

**Full-grown larva.** Length at beginning of 5th stage 7.6 mm, at the end of the stage 13.3 mm; width of head 0.82–0.92 mm. Sclerotized parts reddish yellow or brownish pink.

Head (Figure 494) narrow, oblong, relatively small, dorsoventrally compressed; ratio of width to length 0.60, of width to height 1.4; head slightly narrower anteriorly. Eyes small, double; anterior eye larger than posterior eye. One of the two sensillae of the antennae longer and thinner than the other. Anterior-margin setae of frontoclypeus straight and thin; median setae small; anterior frontal seta curved inward; median seta situated in the anterior third of the sclerite; posterior seta situated near the base of the frontal sutures. Setae 7 and 9 situated posterior to the setae near the base of the mandibles; setae 11 and 10 setuliform; seta 8 directed ventrally; setae 12 and 14 situated posterior to the eye and close together; these setae, and seta 9 are longer than the others. Setae 15, 16 and 17 setuliform; setae 13 and 18 spinelike.

Labrum (Figure 495) 3.6 times wider at the anterior margin than long; dorsal sclerite of labrum pale, thin and trapezoidal, with a median process which reaches the anterior margin; posterior-angle sclerites short and curved inward; setae 1 small and thin, curved inward, situated in the median
370 indentation, on each side of the anterior margin of the process of the dorsal sclerite; the large setae 4 situated posterior to them; setae 2 situated near the angles of the trapezoidal part of the sclerite; setae 6 situated posterior to the pit, thicker than the others; setae 3 situated on the membranous part of the labrum; all the above setae short; setae 2 and 6 longer than the others; setae 5 absent. Mandibles (Figure 496) brown; left mandible with two blunt

apical teeth on the upper blade; lower blade partly serrated, with 2 small apical teeth and a basal tooth; right mandible with a large apical tooth; upper blade with one tooth; lower blade with one tooth and its serrated part with large apical denticles. Sclerites of maxillolabium light (Figure 497); submentum trapezoidal, with relatively long setae near the anterior angles; stipes narrow, oblique, with a blackish brown longitudinal stripe; both setae of stipes situated on the membranous surface, the lateral seta dark, long and strong; ventrolateral sclerite of palpifer with a long distal seta; galea conical, long, hairs of its "fans" dark; a strong, long, sword-shaped black spine at the end of the galea. First segment of palp
371 shorter than the others; 3rd segment longer; sclerites of all segments of palp ring-shaped; sensillae of distal end of palp of the same form, one-segmented. Mentum large; labial lobe blunt, with very short palps.

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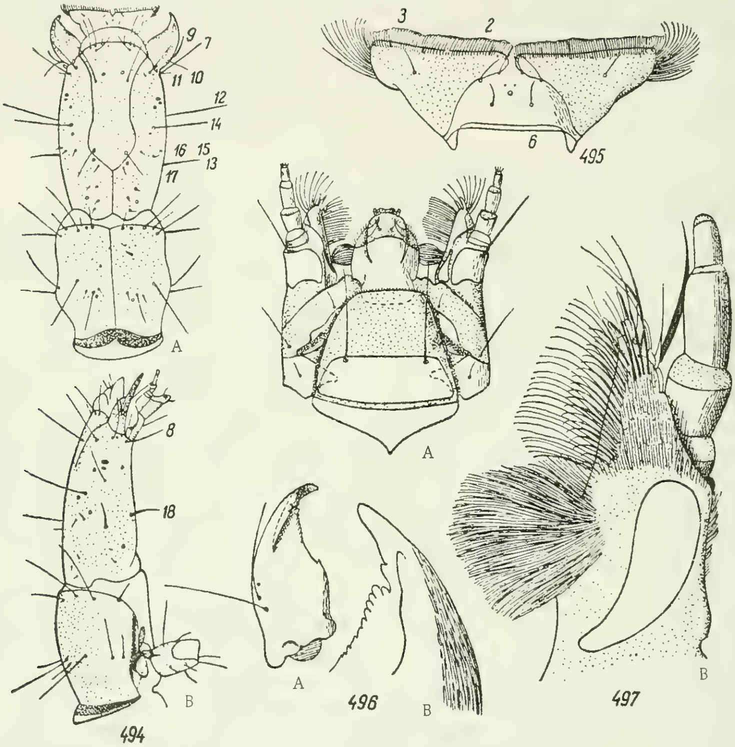

FIGURES 494–497. Wormaldia occipitalis Pict. (after Nielsen):

494 – head and prothorax, dorsal (A) and lateral (B); 495 – labrum, dorsal; 496 – mandibles, dorsal: left mandible (A), distal end of right mandible (B); 497 – maxillolabium (A), right palpifer, galea and palp, dorsal (B).

Pronotum (Figure 494) lighter than head, with indistinct dots near the median line and laterally, where the dots form circles; black posterior margin of sclerite broad in the middle, narrower toward the posterior angle; lateral margin with a dark stripe. Anterior-angle seta $^3/_5$ as long as width of head, longer than the anterior-margin setae; seta 1 of the 5 secondary anterior-angle setae, which are present from the 2nd stage, strong and spinelike, situated between the anterior-angle seta and the anterior angle of the sclerite; one of the 4 setae situated medial to the primary setae, much longer than the other three setae; there are also small and thin secondary setae near the anterior margin, which appear in the 3rd, 4th and 5th stage; slightly posterior to the middle of the sclerite, there is a transverse row of 4 primary setae, 2 of which are long and 2 short; 2 secondary surface setae lateral to the primary seta; the lateral seta of this group spinelike; the secondary setae, which appear latest, occupy the whole anterior part of the sclerite and are light and small. The anterior-angle, anterior-margin and medioanal setae on the dorsum of the meso- and metathorax larger than the others.

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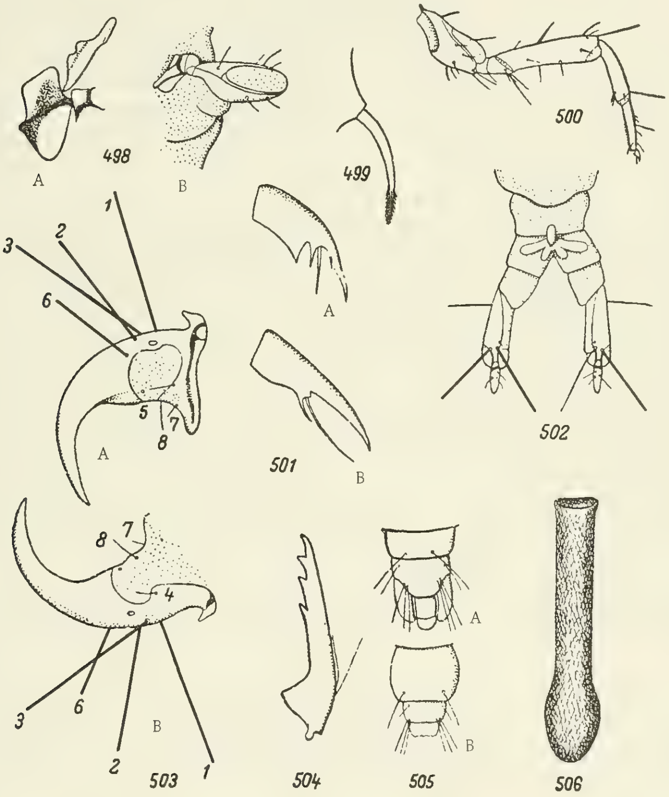


FIGURES 498–506. Wormaldia occipitalis Pict. (after Nielsen):

498 – pleuron and base of coxa of prothorax (A), mesothorax (B); 499 – anterior distodorsal seta of forecoxa; 500 – right midleg, posterior; 501 – claw of midleg of 1st stage (A) and 5th stage (B); 502 – abdominal segments 8 and 9 and anal legs, dorsal; 503 – claw of anal leg, outer view (A) and inner view (B); 504 – left mandible of pupa, ventral; 505 – end of body of pupa, dorsal: male pupa (A) and female pupa (B); 506 – tube, dwelling place of larva.

Episternum of prothorax rhomboidal (Figure 498, A); pleural suture black, the areas adjacent to it brownish black; trochantin oblong, with a light anteriorly-directed fingerlike process with membranous apex and primary seta; seta of epimeron short.

Pleuron of meso- and metathorax small (Figure 498, B); episternum larger than epimeron, with a broad black stripe; setae light, slightly larger than on the propleuron.

Forelegs slightly thicker, midlegs longer than the others (Figure 500); ratio of length of legs 95:100:95. Coxae without basodorsal groove, with a deep distodorsal indentation which occupies the whole width of the coxa; suture of trochanter incomplete; both segments of trochanter fused dorsally; femora, tibiae and tarsi of all legs equally or almost equally broad. Setae of legs short, mainly spinelike; some of them, e. g., the anterior distodorsal seta of the fore coxa, which is situated on a tubercle, pinnate (Figure 499); the ventrodistal setae of coxa and trochanter and the distodorsal setae of the femur are normally developed. Claws straight, slightly curved at the end; a pointed spine near the basal seta (Figure 501).

Abdominal segment 3 slightly broader than the others and slightly broader than metathorax; segment 8 slightly narrower; setae on the dorsum of segments 1–8 like those on meso- and metanotum. Abdominal segment 9 with two broad, slightly divergent appendages delimited anteriorly by a fold which covers the transverse slit of the anus; five anal gills below the anus (Figure 502).

Sclerite "a" of anal legs distinct; sclerite "b" oblong; basal seta and both apical setae relatively long; subapical median seta short; the very short seta of sclerite "c" rather thick. Claw (Figure 503) with broad basal margin, its membranous transverse stripe broad; basal part almost completely membranous in the middle; claw at a right angle at the end; setae 1, 2 and 3 dark, thick and longer than seta 6; setae 4, 5, 7 and 8 thin, short and setuliform.

TABLE 9

(372)

| Setae | Stage | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th |
| Pronotum | | | | | |
| Anterior-margin setae ........ | 0 | 5 | 9–11 | 13–18 | 24–28 |
| Surface setae ............... | 4 | 5 | 11–16 | 40–40 | 65 |
| Mesonotum | | | | | |
| Anterior-angle setae ......... | 1 | 1 | 2 | 3–6 | 7–13 |
| Posterior surface setae ....... | 3 | 3 | 3 | 3–4 | 6 |
| Metanotum | | | | | |
| Anterior-angle setae ......... | 1 | 1 | 2 | 3–6 | 12 |
| Posterior surface setae ........ | 3 | 3 | 3 | 3 | 6 |
| Epimeron | | | | | |
| Prothorax .................. | 1 | 1 | 1–2 | 3–5 | 6–8 |
| Mesothorax ................ | 1 | 1 | 1 | 2–4 | 5–6 |
| Metathorax ................. | 1 | 1 | 1 | 2–3 | 5–7 |

**Young larva.** Length in 1st stage 1.3 mm, in 2nd stage 2.0—3.2 mm, in 3rd stage 3.2—5.1 mm, in 4th stage 4.5—7.8 mm; width of head in 1st stage 0.39—0.41 mm, in 4th stage 0.56—0.65 mm, in 5th stage 0.82—0.92 mm. Sclerites completely light in the 1st and 2nd stages; only posterior part of pronotum with a dark stripe; the light yellow color appears in the 3rd stage, the yellow color in the 4th stage; dark stripes and spots appear on the sclerites of pleuron and anal legs; the mandibles become brownish at the end; a dark border of the pronotum becomes differentiated, and indistinct spots appear on the head and pronotum. Trochantin simple and without process in the 1st stage; a beak-shaped process appears in the 2nd stage; this process has the form of a horn in the 3rd stage; this horn becomes long in the 4th stage, and assumes its definitive fingerlike appearance only in the 5th stage (full-grown larva). Development of the secondary setae of the thorax shown in Table 9 (after Nielsen).

Claws of young larvae relatively longer than in the full-grown larvae; two basal spines near the seta (Figure 501).

**Pupa.** Length of male pupae 5.7—6.5 mm, of female pupae 6.7—7.7 mm. First antennal segment with 2—4 lateral setae. Labrum semicircular; 3 small light setae near the anterior margin, one of them situated behind the other two. Mandibles brown and long, geniculate at the base, pointed and flattened at the end; blade of mandibles serrated, with 3 large teeth near the apex (Figure 504); outer setae of the same length, situated close together near the basal margin; anterior seta of this group light and curved to the surface of the mandible. Natatorial setae dark, dorsal row situated
372 on segments 1—3 of the mid-tarsi, ventral row on segments 1—2; a few setae are also situated on the 3rd segment. Presegmental plates of holding apparatus present on abdominal segments 3—7; postsegmental plates on segment 5; plates and spinules light brown; number of spinules: III:5—7; IV:5—7; V-4—7 + 8—9; VI:1; VII:1(4); spinules arranged in transverse rows on segments 3—5; the anteriorly-directed spinules on the postsegmental plates of segment 5 are arranged in a posteriorly-curved row, which gives the sclerite a concave, spoon-shaped form; presegmental plates of segments 6 and 7 oblong; spine near anterior margin large, strongly curved posteriorly; segment 7 sometimes with 3 or 4 small additional spines. Anal appendages absent; end of body of female pupae blunt; end of male pupae with distinct, large ventral appendages and penis (Figure 505).

Mode of life and habitats. Brook and springs with cool water. The larva makes its tubular galleries on stones (Figure 506).

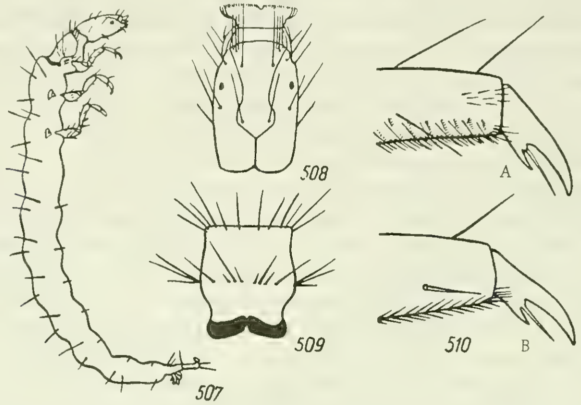
Distribution. West of the European USSR. In addition, Europe.

### 2. **Wormaldia subnigra** McLachlan

Siltala, 1903b:6—10, Figure, 1, a—h; 1905:120—121, Figure 29, a. — Ulmer, 1909:227—294. — Lestage, 1921:469—472, Figure 152. — Lepneva, 1940:203. — Philipson, 1953b:57—62.

**Full-grown larva.** Length 7.0—10.3 mm (Figure 507). Head yellowish brown, slightly lighter laterally and vnetrally; anterior projecting margin of the frontoclypeus slightly darker (Figure 508); indistinct dark dots lateral to the epicranial suture and near the occipital foramen. Both parts of the eye situated close together, sometimes fused. Dorsal sclerite of labrum yellowish white, distinct on the membranous, transparent, white surface of the labrum. Upper blade of left mandible with 2 blunt teeth situated close together; lower blade with 2 pointed teeth near the terminal tooth; a serrated part, with a small basal tooth at the end posterior to these teeth; upper blade of right mandible with one tooth; lower blade with 3 distal teeth (2 very small) and a serrate part; basal tooth absent. Sclerites of maxillolabium yellowish; stipes darker. Setae of head and mouthparts as in Wormaldia occipitalis.

(373)



FIGURES 507–510. Wormaldia subnigra McL. (after Hickin):

507 – full-grown larva, lateral; 508 – head, dorsal; 509 – pronotum; 510 – end of tarsus and claw of forelegs (A) and midleg (B).

Pronotum (Figure 509) narrower posteriorly; posterior margin dark brown, crenulate posteriorly; the white sclerotized area posterior to the margin is as wide as the margin in the middle; setae as in W. occipitalis. The brown stripe is narrow laterally and not as distinct as in W. occipitalis; it bears a black, oblong spot near the articulation with
373 the pleuron, posterior to which is a small lateral process which covers the propleuron posteriorly; posterior quarter of the lateral margin light.

Legs yellowish white, without dots; hind legs thinner and shorter than the others; forelegs only slightly darker (Figure 510). Claws of legs not darker than the other sclerites.

Basal seta of coxa of all legs displaced from the margin of the sclerite; this seta is long on forelegs and midlegs (longer than the coxa); it is short on the hind legs (less than half as long as the coxa); anterodorsal seta of forelegs forming a long, thick, blunt, light yellow spine.

Sclerite "b" of anal legs with brown spots in the middle and distally; claw brown at base and apex.

**Pupa.** Length of male pupae 5–6 mm, length of female pupae 6.5–7.0 mm. Antennae of male pupae reaching end of abdominal segment 7, of female pupae segment 5 or less. All three setae at anterior margin of labrum transparent, small and thin; median setae slightly longer than the others. Mandibles as in Wormaldia occipitalis.

Wing sheaths of male pupae reaching end of segment 4, those of female pupae end of segment 3. Claws of forelegs and midlegs slightly yellowish; claws of hind legs transparent.

Presegmental plates of holding apparatus on abdominal segments 3–7 very small; postsegmental plates on segment 5 slightly larger. Last body segment of female pupae blunt; last segment of male pupae with ventral appendages which are longer than the penis.

Mode of life and habitats. Running cool water with rapid or slow current.

Distribution. Northwest, west and central belt of the European USSR, Caucasus. In addition, Central and northern Europe.

## 2. Genus **Philopotamus** Stephens

**Full-grown larva.** Large, to 22 mm long. Head almost twice as long as pronotum with almost parallel sides. Frontoclypeus with asymmetrically incised anterior margin; right and left mandibles with teeth at the blades; both outer setae straight, situated at a distance from the basal margin.

Pronotum with broad black posterior margin, which extends, unlike in Wormaldia, also on the lateral margin. Basal seta of claws of legs situated on a tubercle, at the base of which is a short, blunt, basal spine on midlegs and hind legs. Claws of holding apparatus short and strong.

**Pupa.** Length of female pupae 12–13 mm, length of male pupae about 11 mm. Antennae thin, reaching end of segments 5–6. Labrum broad, with 5 setae at the anterior margin; the 2 lateral of these setae longer than the 3 median setae; mandibles long and strong as in Wormaldia,
374 geniculate at the base, with 3 serrated apical teeth and 2 short basal setae of almost the same length.

Plates of holding apparatus present on segments 3–7, little developed. Ventral appendages of male longer than penis.

Case made of small stones; pupae lying in a yellowish brown cocoon.

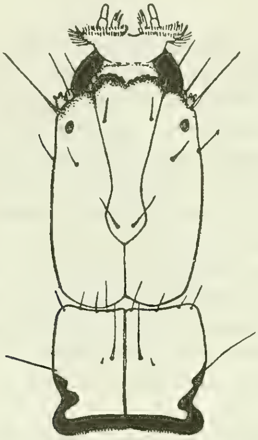
Mode of life and habitats. Brooks and rivulets with cool water, under stones; mainly in mountain regions.

Distribution. West of the European USSR, Caucasus. In addition, Europe.

### 1. **Philopotamus montanus** Donovan

Pictet, 1834:210, Plate XVIII, Figure 5. — McLachlan, 1865:139–140, Plate 2, Figure 7. — Morton, 1888b:89–91. — Klapálek, 1893:112–115, Figure 3, C. — Ulmer, 1903:117, Figures 10, 21, 35, 71, 80; 1903c:347, Figure 1; 1909:227, 294, Figure 352. — Siltala, 1905:119–121, Figure 28; 1907:398–401, Figure 4, a–b. — Lestage, 1921:473–476, Figure 153. — Hickin, 1942:16–17, Figures 1–5.

**Full-grown larva.** Large, 20–22 mm long. Head (Figure 511) oblong, twice as long as pronotum, with almost parallel sides, shining, chestnut brown, darker anteriorly; projecting anterior margin of frontoclypeus asymmetrically incised; a transverse row of 4 indistinct dots in the middle of the sclerite. Gula short, broadly triangular. Eyes displaced to near the anterior margin, situated on a light background; setae of head short and dark. In addition to the short primary setae and marginal hairs of the labrum (Figure 512), there are short hairlike chetoids dorsally, near the margin of the lobes and lateral to the white indistinct median sclerite. Mandibles with strongly curved outer margin and almost straight median margin which bears teeth; median margin prolonged into a beak-shaped tooth at the end; upper blade of left mandible with an apical tooth in addition to the terminal tooth; lower blade with a serrated part, an indentation and 2 apical teeth; lower blade of right mandible with a serrated part, an indentation and a blunt basal tooth. Submentum trapezoidal; setae near the anterior angles relatively large, longer than the other setae of the maxillolabium.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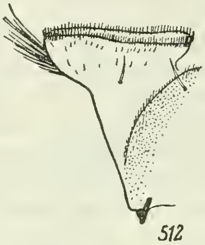
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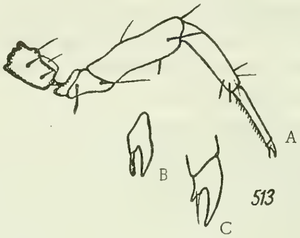

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FIGURES 511–513. Philopotamus montanus Don. (after Hickin):

511 — head and pronotum; 512 — labrum (part); 513 — legs: foreleg, anterior (A), claw of foreleg (B), apex of tarsus and claw of midleg (C).

375 Pronotum (Figure 511) and head chestnut brown, without pattern; posterior margin of sclerite and posterior half of lateral margin with a broad black border which extends in a narrow stripe to the anterior angle; anterior-margin and anterior-angle seta of sclerite short; medioanal and lateral setae longer than the others. The mesothorax is the largest segment of the body, raised in form of a hump above the pronotum.

Trochantin of prothorax with a long horn-shaped process.

Legs of the same length; forelegs brownish, the other two pairs (Figure 513) pale. Tarsi of legs almost as long as the tibiae; ventral side of fore tarsi with a row of short thin spinules (Figure 513, A); mid- and hind tarsi with only distal spinules; claw (Figure 513, B) with a basal process with a seta; a spinelike process basal to this process on the midlegs and hind legs.

Claw of anal legs strong and strongly curved.

**Pupa.** Length of male pupae 11 mm, of female pupae 13 mm. Antennae filiform, thin, reaching middle of segment 6 in male pupae, segment 5 in female pupae; 1st segment larger than the others; labrum broad, with slightly rounded anterior margin and indistinctly marked angles; each angle with a long seta; 3 such setae and a longer seta laterally at the anterior margin. Mandibles strong and long, curved at the base, with 3 apical teeth; teeth and blades finely serrated; outer setae almost of the same length. Maxillary palps 5-segmented; terminal segment longer than all the other segments together; labial palps 3-segmented; the last segment as long as the two preceding segments together. Wing sheaths short and pointed, of different length, second pair reaching the middle of abdominal segment 3. Mid-tarsi with blackish brown, dense natatorial setae and strong claws. Holding apparatus of segments 3—7 weakly developed; number of spinules as follows: III:3—6; IV:3—7; V:3—5 + numerous minute spinules on the postsegmental plates; VI:6—9. The long ventral appendages of the male genitalia are divided to the middle; penis sheath short.

Mode of life and habitats. Brooks and rivulets with cool water and rapid current. The record of Ph. montanus from the Molozhskii area of the Rybinsk Reservoir is doubtful.

Distribution. Northwest and west of the European USSR. In addition, Europe.

### 3. Genus **Dolophilodes** Ulmer

**Full-grown larva.** Length about 14—15 mm. Head oblong, almost twice as long as pronotum in some Middle Asian species, brownish or chestnut brown, without pattern; frontoclypeus asymmetrical anteriorly; gula short, broadly triangular, partly projecting beyond the head capsule. Eyes small, situated close to the anterior margin. Labrum with a weak, light dorsal triangular sclerite in the middle; anterior membranous margin of labrum straight; row of minute hairs on it continuous; median indentation hardly marked. Mandibles large and strong, black or blackish brown, with an undulate outer surface, and with two light setae, which are widely separated and situated at a marked distance from the basal margin. Pronotum and head brownish or chestnut brown, with straight lateral margin; posterior angles slightly prolonged; a broad and continuous black border at the posterior and lateral margin; margin light and milk white posteriorly; posterior area of sclerite broader in the middle than laterally. Trochantin prolonged in a horn, shorter than in Wormaldia and Philopotamus.

Legs of almost the same length; forelegs slightly darker than the other legs; hind legs shorter and thinner. Anterodorsal seta of fore coxa dark, spinelike, resembling the basal seta of the coxa. Tarsi of forelegs with a continuous row of small light ventral spinules. Similar spinules in the distal part of mid- and hind tarsi. Claws with a process near the long light seta. Abdominal segments (except segment 9) uniformly broad, as in the other genera; claws of anal legs dark. This genus has been little studied.*

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* In addition to the larva described below (from the vicinity of Lake Teletskoe), the collections of the Zoological Institute also contain several larvae of Dolophilodes of an unidentified species from Kirghizia and Tadzhikistan; these specimens were used for the description of the genus.

Mode of life and habitats. Cold-water streams, under stones.

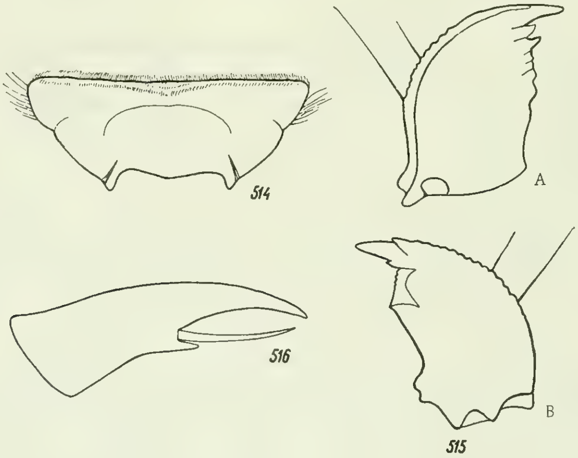
Distribution. USSR: Caucasus, Altai, Middle Asia, Far East. In addition, Japan, China, India.

376 1. **Dolophilodes** sp.

Lepneva, 1949:167–168, Figures 15–20.

**Full-grown larva.** Length about 14 mm. Head and pronotum light brown, without dots; legs and sclerites of anal legs yellowish. Eyes situated near the anterior margin of the head, small and undivided. Labrum (Figure 514) with transparent white lobes and a little differentiated white, thin, dorsal sclerite. Outer margin of mandibles (Figure 515) slightly concave in the basal half, undulate at the lower and upper margin; upper blade of left mandible with one tooth; lower blade with 2 apical teeth in addition to the terminal tooth, a serrated part and a broad, blunt, basal tooth; right mandible with one tooth on the upper blade; lower blade with a distal tooth and a small serrated part, in addition to the apical tooth; outer setae situated in about midlength of the mandible; anterior seta shorter than posterior seta. Black border at sides and at posterior margin of the pronotum broad and continuous. Claws of legs (Figure 516) with a long basal part; seta light, thick; spinelike process at the base blunt.

Mode of life and habitats. Tributaries of Lake Teletskoe, small rivulets with stony bottom and cool water.



FIGURES 514–516. Dolophilodes sp.:

514 – labrum, dorsal; 515 – mandibles, dorsal: left mandible (A), right mandible (B); 516 – claw of foreleg.

### 4. Genus **Chimarrha** Stephens

**Full-grown larva.** Length 7–8 mm. Anterior margin of frontoclypeus with a deep asymmetrical indentation. Coxa of forelegs with a large, massive spinelike process distodorsally. Abdomen white or pale yellow.

Mode of life and habitats. Rivulets with clean cool water and rapid current; on stones.

Distribution. West of the European USSR (Karelia, Latvia, Lithuania). In addition, Europe, Africa, southern Asia, Philippines, North and South America, Australia.

### 1. **Chimarrha marginata** Linné

Marlier, 1943a:1–8, Figures 1–8.

**Full-grown larva** (Figure 517). Length 6.0–7.5 mm. Form of body as in Wormaldia. Head oblong, amber yellow, darker than in Wormaldia, but not as dark as in Philopotamus; anterior margin of frontoclypeus
377 brownish, deeply asymmetrically indented in the middle; left margin of indentation projecting further than right margin; eyes as in Wormaldia, situated at a distance from the anterior margin.

Labrum dorsally (Figure 518) as in Philopotamidae, membranous in its greater part; lateral ligulate processes, which are curved ventrally when the insect retracts the labrum near the anterior margin; a row of small straight hairs at the anterior margin; ventrolateral tufts of hairs smaller than in Wormaldia and Philopotamus. Mandibles (Figure 519) brown, massive; upper blade (except the small distal part) reduced; apical tooth of left mandible pointed; 2 smaller subapical teeth; right mandible with blunt apex and with a pointed subapical tooth; median margin of lower blade of both mandibles serrated; outer setae long, situated behind each other, slightly away from the basal margin.

Pronotum brown, lighter than head; posterior margin and basal part of lateral margin with a broad dark border (Figure 517).

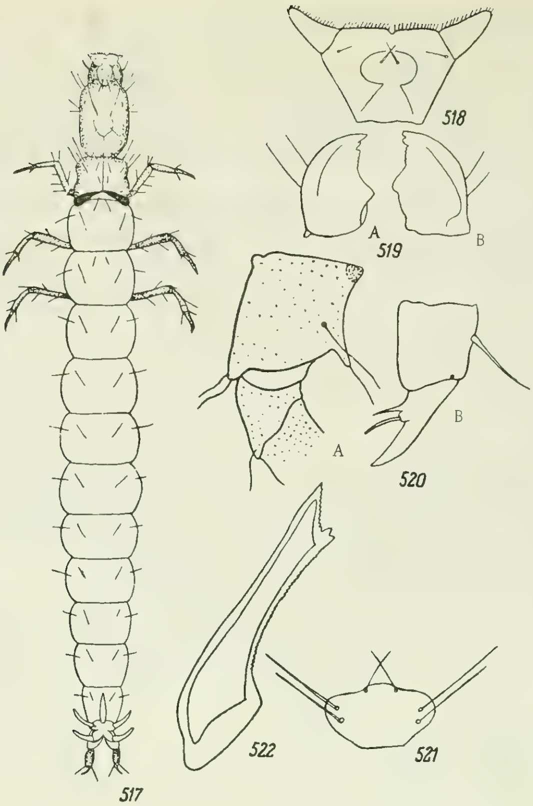
Legs light yellow; forelegs slightly shorter and thicker than the others; midlegs and hind legs of almost the same length. Coxa of forelegs short (Figure 520); dorsal articular process black; with a larger anterior spinelike process with a strong, black, short, primary seta dorsally; basoanterior
378 seta also short and strong. Claws of legs slightly curved; a pointed spine near the basal seta.

Abdominal setae small, black, well marked. Five anal gills.

Anal legs short, simple; claw as in Wormaldia, strongly curved and slightly larger.

**Pupa.** Length 5–7 mm; form of body and length of antennae as in other Philopotamidae. Labrum broadly rounded (Figure 521); median process broad, little marked; a short black seta near the anterior margin; 2 strong, dark, long setae laterally on the labrum. Mandibles (Figure 522) as in Wormaldia, dark brown, sharply curved at the base, straight in the other part, pointed; medial subapical process with 2 small denticles; median blade finely serrated apically and basally to the process.

Wing sheaths short and pointed; mid-tarsi with dense natatorial setae; claws strong, strongly curved, dark at the end.



FIGURES 517–522. Chimarrha marginata L. (after Marlier):

517 – full-grown larva, dorsal; 518 – labrum; 519 – mandibles, dorsal: left mandible (A), right mandible (B); 520 – foreleg: coxa and base of trochanter (A), apex of tarsus and claw (B); 521 – labrum of pupa; 522 – left mandible of pupa, ventral.

Holding apparatus well developed; presegmental plates present on segments 3–8; postsegmental plates on segment 5; number of crotchets as follows: III:4–5; IV:4–5; V:5+ 9; VI:9; VII:4; VIII:3–5; crotchets of different length; postsegmental plates of segment 5 with 3 large and 6 minute crotchets; presegmental plates on segment 6 with 6 large and 3 minute crotchets; segment 8 with 1 or 2 large and 2 small crotchets.

Mode of life and habitats. Brooks with cool, clean water and rapid current.

Distribution. West of the European USSR (Sortavala, Latvia, Lithuania). In addition, Europe.

## V. Family STENOPSYCHIDAE Martynov

**Full-grown larva.** Large, 45–50 mm long. Sclerotized parts yellow or yellowish brown, with a dark, distinct, punctate pattern; membranous parts of live specimens greenish.

Head oblong, narrow; prothorax as broad as head, much narrower than the following thoracic segments. Antennae as in Philopotamidae, situated near the margin of the gnathal opening. Eyes situated on a light background, close to the anterior margin. Frontoclypeus long, as in Philopotamidae, with projecting anterior part and a shallow lateral indentation; coronal suture relatively longer than in Philopotamidae, more than half as long as the frontoclypeus (a third as long as this sclerite in Philopotamidae). Gular suture long; gula small, triangular. Labrum short and broad; dorsal sclerite wide, covering the whole labrum except a narrow membranous stripe at the anterior margin which bears a dense brush of light, grayish hairs; median indentation small, rounded, with small lateral tubercles anteriorly. Mandibles strong and black, blackish brown in part, with apical teeth; left mandible with a brush of setae in the median depression; outer setae moderately long in the middle. Mentum large, with a rounded process in the middle of the anterior margin.

Pronotum with broad, black posterior margin and a large black spot at the lateral margin; posterior angle of sclerite curved ventrally. Punctate pattern distinct. Propleuron with a short conical process of the trochantin; epimeron unusually large, extending to the median line on the ventral side. Prothoracic sternite in form of a strong black median sclerite with wide, long posterolateral plates.

Mesothorax narrower anteriorly; longer than the metathorax; pleural sclerites forming narrow black sclerites, which correspond to the pleural groove (transverse plate) and the moderately long distal margin of episternum and epimeron (longitudinal plate).

Legs of almost the same length; midlegs slightly longer than the other legs. Coxae of forelegs without dorsal groove and distodorsal indentation, with a more or less large basodorsal process. Coxae of midlegs and hind legs with a shallow distodorsal indentation, without dorsal tubercles. Only primary setae present. Claws of legs with a hooklike basal process; a light primary seta at the apex of the process of the forelegs; such a seta absent on the process of midlegs and hind legs.

First five abdominal segments of about the same width; the abdomen gradually tapers posteriorly; segment 9 narrow, cylindrical, without dorsal sclerite. Tracheal gills absent; anus forming a transverse slit; five anal gills. Anal legs relatively short; section "a" membranous; sclerite "b"
379 with large dark dots. Claw short, strong and curved at a right angle.

**Pupa.** Length about 22–25 mm. Antennae longer than body; 1st segment with a brush of setae. Labrum with three setae laterally at the anterior margin. Mandibles long, geniculate, with a straight, coarsely serrated blade; outer setae short. Wing sheaths blunt, reaching middle of abdomen. Natatorial setae present on segments 1–4 of mid-tarsi. Ventral appendages of male genitalia long and curved; penis short and broad.

Pupal case large and elliptical, to 30 mm long, made of small stones and large sand grains, thick and strong; ventilation holes present between the sand grains.

Mode of life and habitats. Streams in foothills, on pebble bottom; under stones.

Distribution. USSR: Altai, Sayans, Eastern Siberia (southern part), Sakhalin, Maritime Territory. In addition, eastern and southern Asia, Africa (rare).

## 1. Genus Stenopsyche McLachlan

Martynov (1926c) revised the classification of the family and included 3 genera: Stenopsyche McLachlan, Stenopsychodes Ulmer and Pseudostenopsyche Döhler. Only the first genus occurs in the USSR. Martynov (1926c) placed the species S. bergeri described in 1926 in genus Stenopsyche. Later, when Kuwayama described the new genus Parastenopsyche in 1930, Martynov (1934) placed bergeri in the genus Parastenopsyche Kuw.; he stated that the two genera were very similar and differ only in the number of spurs on the forelegs of males and females and in the length of abdominal segment 10. Mosley wrote to Martynov (9 September 1935) that separation of a genus on the basis of the formula of the spurs is not justified in his opinion, and the genus Parastenopsyche should be sunk and its species transferred to Stenopsyche.

"I am not accepting any new genera, based on the variation of the spur formula, and as a consequence sink Kuwayama's genus Parastenopsyche when I come to it, transferring all the species to Stenopsyche."

The larvae of the St. griseipennis and St. bergeri differ only in minor characters, mainly in color and this confirms the original view of Martynov (1926c) on the systematic position of St. bergeri; we accept this view here.

### Key to Species of Stenopsyche

Full-grown larva

1 (2). Dots on head and thorax situated on dark stripes; frontoclypeus with a broad dark longitudinal stripe; basodorsal process of coxa of forelegs conical, large, pointed . . . . 1. **St. griseipennis** McL. (p. 424)

2 (1). Dark stripes absent or indistinct; dark longitudinal stripe on frontoclypeus absent; basodorsal process of fore coxa much smaller, with rounded apex . . . . . . . . . . . . . . . 2. **St. bergeri** Mart. (p. 435)

### 1. Stenopsyche griseipennis McLachlan

Martynov, 1926c:291—298, Figures 9—14. — Iwata, 1927a:208, Plate I, Figure 3, Plate III, Figures 61—68.*— Kuwayama, 1930:113, Figure 2. — Lepneva, 1940:203; 1948a:229—235, Figures 1—8.

**Full-grown larva** (Figure 523). Length 45—50 mm. Color of sclerotized parts reddish brown, with a distinct punctate pattern; rows and groups of dots and isolated dots present on a dark background. Length of head

* Described as Philopotamopsis japonica n.sp.

6.5—7.0 mm; head wider posteriorly, 1.8 mm wide at the level of the eyes; 2 mm wide posteriorly; ventral side slightly concave in profile; dorsal side slightly convex; length of frontoclypeus 3.4 mm, length of coronal suture 2.2 mm. Setae relatively short, most of them brown and moderately thick (Figure 524).

380 Antennae situated at the anterior margin and differentiated as a small light spot; both antennal sensillae cylindrical, brownish; setae transparent; 2 of them relatively large, the third small. Eyes small, situated on a large, whitish yellow spot in the anterior part of the head. Gula dark brown. A large median dot near the anterior margin of the frontoclypeus; short, dark longitudinal stripes with three large dots on each lateral to this dot; two large dark dots near the stripes; a dark triangular spot near the anterior curve of the frontal sutures; a broad, dark longitudinal stripe in the middle of the sclerite; anterior half of this stripe with two large asymmetrical dots; 4 or 5 dots near the curvature of the frontal sutures; posterior part of sclerite with a curved transverse stripe with 10—12 minute dark dots and two large dots; a large dark dot anterior to the base of the posterior frontal seta. Margins of sclerite dark at the curvature of the frontal sutures; a short stripe with a dark dot lateral to the suture. Rows and groups of large blackish brown dots lateral to the epicranial suture and on the sides of the head, from the posterior margin of the periocular area to the occipital foramen; a large dark dot on both sides of the gular suture in the anterior third of the ventral side; stripes and spots with rows and groups of two to five dots further posteriorly; two large dots in the posterior quarter of the head lateral to the suture; groups of small dots near the occipital foramen.

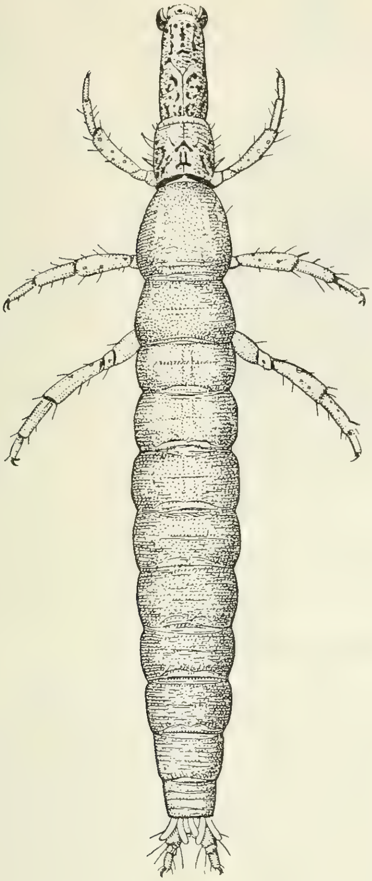


FIGURE 523. *Stenopsyche griseipennis* McL. Full-grown larva

Median and intermediate anterior-margin setae of the frontoclypeus straight and brown, directed anteriorly, relatively long, reaching anterior margin of the labrum; lateral seta transparent, curved to the anteclypeus. Anterior and middle frontal setae situated on a dark spot near the curvature of the anterior branch of the frontal sutures; the former seta transparent and curved, the latter inclined anteriorly and brown; posterofrontal seta similar, situated near the transverse stripe of dots. Setae 9 and 7 brown, situated near the anterior margin of the head, at a distance from the eye; setae 11 and 10 small and transparent; the brown, moderately thick setae 14 and 12 are situated posterior to the periocular area; seta 16 situated posterior to them; seta 15 small and light; seta 17 short and slightly thinner than the others, situated slightly asymmetrically posterior to the bifurcation of the frontal sutures. Ventral seta 8 situated near the anterior margin, thin, brown, resembling seta 7; seta 18 dark brown, spinelike, situated in the posterior half of the head, widely separated (Figures 524, 525).

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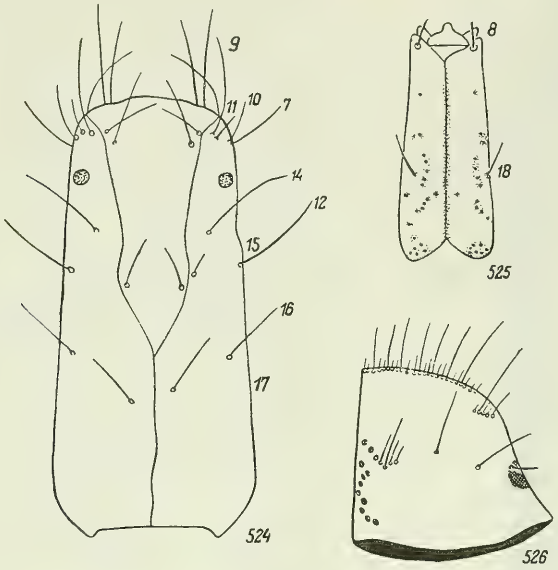
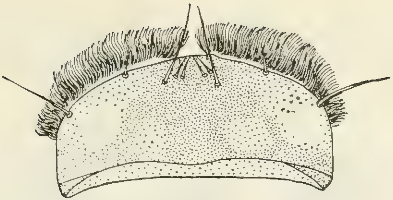


FIGURES 524–526. Stenopsyche griseipennis McL.: 524 – head, dorsal; 525 – head, ventral; 526 – pronotum.

Labrum (Figure 527) with yellowish hairs near the anterior membranous margin; dorsal sclerite yellowish brown, dark brown in the middle and near the posterior angles; seta 1 not visible among the hairs; seta 3 short, light, situated near the anterior margin; seta 5 larger, situated near the margin; seta 6 also brown, large; setae 2 and 4 small, light, situated close together lateral to the median indentation.

Mandibles (Figure 528) with broad, yellowish, concave outer side; upper blade little marked. Left mandible with a large distal tooth on the upper blade; lower blade of left mandible with 3 teeth in addition to the apical tooth; middle tooth of this group small; in addition to the two large teeth of the upper and lower blade, apical part of left mandible with one or two
381 additional teeth, one of them very small; a brush of dense, shining golden chetoids in the median depression. Upper blade of right mandible with 2 teeth, a large apical tooth and a small little marked tooth near it; lower blade with 3 teeth in addition to the apical tooth; middle tooth of this group very small. Outer setae of mandibles situated in a dorsal groove, they are almost of the same length, situated at a distance from the base and from each other; basal seta brown and almost straight; apical seta curved and lighter.



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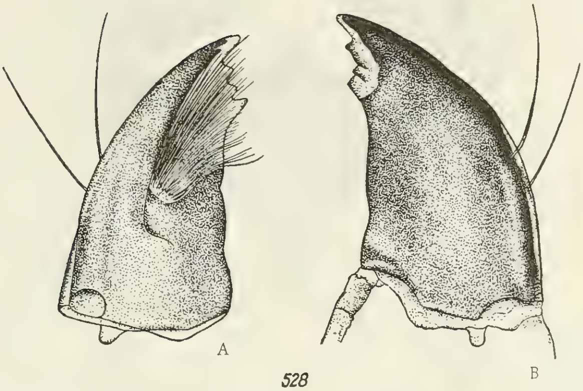

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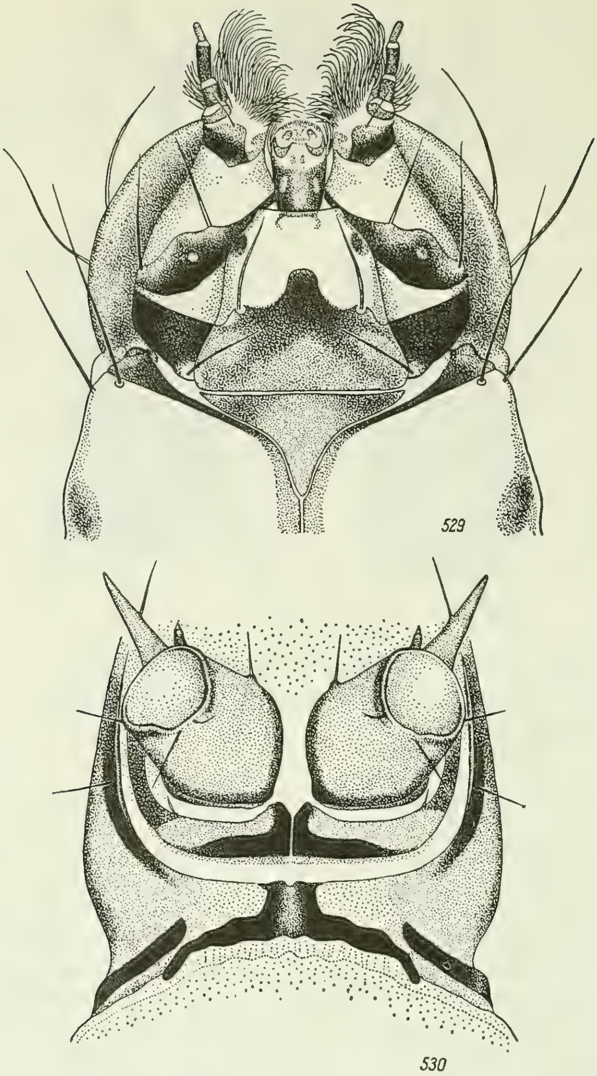
FIGURES 527 and 528. Stenopsyche griseipennis McL.: 527 — labrum; 528 — mandibles, dorsal: left mandible (A), right mandible (B).

Maxillolabium (Figure 529) with yellowish white membranous parts and with distinct brown and dark brown sclerites, some of which are blackish; setae brown or dark brown. Submentum dark brown, blackish brown near the posterior angles and anteriorly near the base of the rounded median process; setae on the processes on the anterior angles situated on small light spots; each lateral fold of the submentum with a small, dark brown, rounded sclerite. Sclerites anteriorly, on the membranous part of cardo dark brown on the outer side near the base and in the middle near the posterior angle; a strong dark brown seta near the posterior median angle; sclerites of stipes oblique, with a broad blackish brown stripe in the middle and with a small, round light spot; narrow distal end of sclerite blackish; both setae of the sclerite strong, dark brown. The sclerite of the palpifer blackish brown in its greater part, light brown anteriorly; a thin brownish, relatively large seta distally in the middle; first segment of the maxillary palp broad and short, its sclerite much shorter and broader than the others; 2nd segment slightly broader than 3rd; 3rd segment slightly curved, longer than the others, with a dark brown sclerite; 4th sclerite small, narrower distally, with short sensillae. Galea short and broad, with dense, yellowish curved hairs; sensillae and setae indistinct among the hairs. Mentum slightly oblong, dark brown in the middle and at the base; ventral sclerites small, rounded, light brown, with a small seta; labial palpifer reddish brown; labial palps narrow, short, with brownish sclerites and relatively long sensillae; distal process of labial lobe short.



FIGURES 529 and 530. Stenopsyche griseipennis McL.:

529 – anterior margin of head, ventral and maxillolabium; 530 – prothorax and coxae, ventral.

382 Prothorax cylindrical (Figure 523), oblong; pronotum reddish brown, with broad black posterior margin; anterior angles rounded, with a brown spot; lateral margin with a narrow reddish brown stripe in the anterior half, with a large, black spot posteriorly; posterior-angle part prolonged and curved ventrally (Figure 530). The pattern consists of a T-shaped, punctate figure with 3 or 4 large dots in the anterior oblique rows and with 6–8 small dots in the longitudinal rows; wide groups of dots forming rings

or rows in each half of the sclerite; these dots reach the posterior margin of the sclerite and leave only its anterior part free (Figures 523, 526).

Setae relatively short; anterior-angle setae situated on a short, dark transverse stripe, at a distance from the anterior margin; primary anterior-angle seta moderately long, thick, blackish brown; one of the secondary setae situated lateral to the primary seta, short and brown; the 3—5 other setae thin and small; median part with two relatively long and thick brown setae near the anterior margin, which are slightly smaller than the primary anterior-angle setae; 3 or 5 shorter setae between these setae and 2 or 3 such setae further medially; 19—22 thin, short, anteriorly-directed transparent setae among the above setae, the lateral seta slightly longer than the others; the anterior-margin group of setae therefore consists of 26—32 setae. Three surface setae dark brown, relatively thick and almost as long as the primary anterior-angle seta; they are situated at about an equal distance from each other; median primary surface seta situated near the T-shaped punctate figure; 2 thin, dark, short setae and a small seta near it; second long surface seta situated among the dots and a small thin seta near it; a third long surface seta lateral to the dots; a dark brown moderately long seta on the black lateral spot.

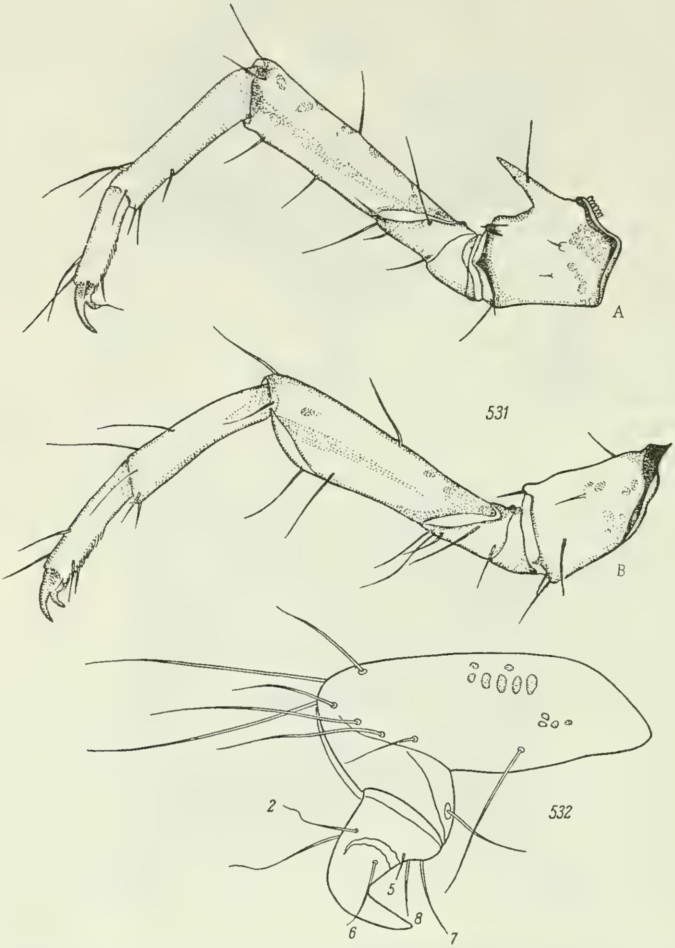
383 Prothoracic pleuron reddish brown, with a short black suture; narrow conical process of trochantin with a blackish brown margin basally and laterally, and with 2 light setules and a short light brown seta; the epimeron surrounds the coxa and reaches the ventral region, where the epimera of both sides almost touch in the middle; they are separated only by a narrow light membranous stripe; median part and posterior margin of ventral 384 process of epimeron reddish black (Figure 530); epimeral seta small and light, situated between pleural and ventral region.

Sternite black, consisting of a small median part and curved, posterior-angle stripes extending at the sides posterior to the ends of the black margin of the pronotum (Figure 530).

Meso- and metanotum with a sparse pattern of white dots in stripes and spots. Anterior-angle, anterior-margin and medioanal surface setae brown and thin; the latter slightly longer than the others; secondary anterior-angle setae, intermediate and lateral surface setae small and thin. Anterior-margin setae of metanotum light, shorter and thinner than those of mesonotum; other setae similar. Pleural sclerites of meso- and metathorax short and dark brown; episternal seta thin, situated distally; epimeral seta small, light brown, little marked, situated ventral to the sclerite.

Coxa of forelegs (Figure 531, A) with a group of large dark brown dots anterobasally, near the black margin; dorsal process massive, conical, large and pointed with a blackish brown strong basal seta on the anterior surface; distodorsal anterior seta very small, light and thick, situated on a small tubercle; posterior apicodorsal seta brown, longer and thinner than the basal seta; both anterior surface setae small, one of them strong, blackish brown, situated on a small tubercle near the basal group of dots; the second situated further ventrally, thin and brownish; anterior disto-ventral seta small, thin; posterior seta long, brown and slightly shorter than the basal seta. Basal segment of trochanter not closed, but its dorsal ends almost contiguous; anterior seta of trochanter brown and long, situated near the distal margin; posterior seta yellowish, small, situated subapically; basal seta of the 3 anteroventral setae situated near the suture, brown, straight, slightly longer than the strong dark brown apical seta; a light, spinelike seta curved like a horn near the latter seta; the apical seta of the 2 posteroventral setae brown, very thin at the end; it is the longest seta of the segment; second seta situated near the apical seta, small and black.

(385)



FIGURES 531 and 532. Stenopsyche griseipennis McL.:

531 – right legs, anterior: foreleg (A), midleg (B); 532 – right anal leg, outer view.

Femur straight, slightly broader apically; distoventral indentation shallow; femur with a narrow longitudinal dark stripe anteriorly and posteriorly; a row of coarse dots dorsal to this stripe, on the anterior surface of the femur; 3 large dark brown dots posteriorly, at an equal distance from each other; apical margin of femur dark; setae short and almost of the same length; dorsal setae brown, one near the middle and the second apically; anterior seta dark brown, situated above the stripe;

posterior seta slightly longer, brown, situated near the end of the stripe; both setae situated subapically; ventral setae slightly shorter than dorsal setae, straight, light brown; one of them situated almost in the middle of the femur and the other subapically.

Tibia straight, slightly narrower apically with several dots near the basal margin; dorsal setae situated one behind the other, close together; anterior seta transparent, thin, curved; posterior seta much longer, light brown; anterior surface seta brown, strong, short; posterior seta much longer and thinner, situated near the distoventral seta; both ventral setae yellowish brown, shorter than the setae on the femur; subapical seta situated at a distance from the apical seta, and shorter.

Distal half of tarsus with ventral combs which consist of straight yellow spinules which are longer toward the end of the segment; the apical seta of the 2 dorsal setae longer than the others, straight and dark brown; subapical seta light yellow and slightly curved; both distoventral setae yellow, situated laterally to the comb of spinules. Claw dark brown, black at the base, blunt, with a massive basal process, with a soft white seta at the apex.

Coxae of midlegs (Figure 531, B) and hind legs with a deep dorsodistal indentation, which reaches almost the middle of the segment;* dorsal groove weakly marked; dots near the basal margin indistinct. Basal seta of coxa brown, thin and small, smaller and situated in the area of the dots on the hind legs; anterior dorsodistal seta strong, dark brown, situated on the margin; it is situated on a small tubercle, on the midlegs; without tubercle on the hind legs but slightly longer than on the midlegs; posterodorsal seta brown, thin, longer on the hind legs; one of the 2 anterior surface setae situated near the group of dots, the other longer and situated subapically; both setae reddish brown; posterior ventrodistal seta almost twice as long as the anterior seta.

Both segments of the trochanter of midlegs and hind legs not closed dorsally and with a black spot; anterior and posterior setae thin, dark brown the former longer than the latter; the basal seta of the 3 anteroventral setae situated near the suture, strong, blackish brown; apical and subapical setae thin, dark brown; the former slightly larger than the latter; posterior distoventral seta dark, the longest seta of the segment; second posterior
385 seta spinelike, light brown, situated in about the middle of the segment.

Femur of midlegs and hind legs broader apically, with a deep ventrodistal indentation which extends on the midlegs to about half the length of the segment; it extends slightly farther on the hind legs; a dark longitudinal stripe with dots above it on the anterior surface; an indistinct stripe and dots posteriorly; dorsal setae thin, reddish brown, one situated in the middle of the segment, the other distally; anterior and posterior surface setae of almost the same length, brown; ventral setae slightly longer and thicker than the others, situated near the margin of the indentation; posterior seta situated distal to the anterior seta.

Tibia and tarsus as on the forelegs. Apicodorsal seta of tibia light brown, slightly longer and thicker than the subapical seta; anterior seta
386 dark brown, large, situated close to the apicodorsal seta; posterior seta shorter, situated near the ventrodistal setae; both ventrodistal setae small, spinelike, thick and yellow. Spinules of ventral comb of tarsus slightly

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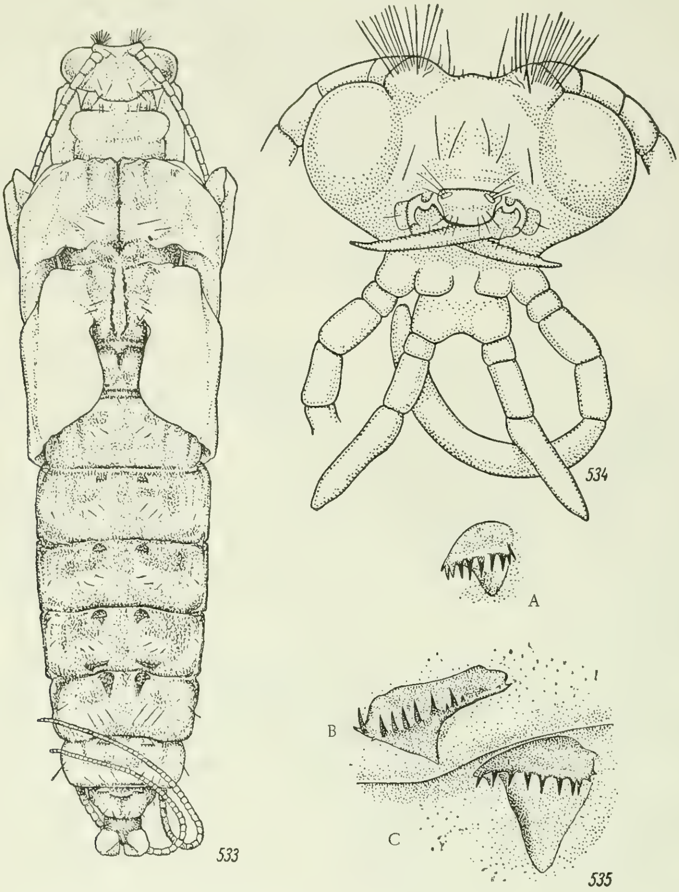
* This indentation is not visible anteriorly in Figure 531.

longer than on the forelegs; apical and subapical seta situated dorsally; the former reddish brown and straight, almost as long as the claw; ventral setae straight and yellow, situated on both sides of the row of spinules.

Claw slightly longer than on the forelegs, reddish brown; basal process hooklike; basal seta absent.

(387)



FIGURES 533–535. Stenopsyche griseipennis McL., pupa:

533 – pupa, dorsal; 534 – head, anterior; 535 – presegmental plate of segment 4 (A), postsegmental plate of segment 5 (B); presegmental plate of segment 6 (C).

Segments 1–6 of abdomen almost uniformly broad; segment 7 slightly narrower than the preceding segments; segment 8 and especially segment 9 much narrower. Segment 1 shorter than 2, fused with the metathorax. Abdominal segments with a pattern of thin white stripes and dots, which are not as rich as on the thorax. Setae thin, brown or dark brown. Anterior-angle setae of segments 7 and 8 longer and stronger than on the preceding segments, dark brown; they are displaced posteriorly on segment 8 and form a row with the surface setae. Anterior-margin setae of segment 1 small, light yellow; they are even smaller and hardly marked on the following segments; they are dark and more distinct on segments 7 and 8; Medioanal seta of anterior and middle segments smaller, lighter and thinner than anterior-angle seta; both setae similar and blackish brown on segments 7 and 8; intermediate and lateral surface setae thin and small, almost transparent, situated on small white spots lateral to the median seta; Ventral medioanal seta of 1st segment small, light brown; that of segments 2 and 3 much larger; it is very small and light on the following segments, especially on segments 4 and 5; this seta is also dark brown on segment 8 and relatively long, like the anterior-angle seta.

Segment 9 laterally, with 3 strong reddish brown setae near the base of the anal legs, one at the boundary with the dorsal part and 2 setae close together at the boundary with the ventral part.

Section "a" of anal legs (Figure 532) almost completely membranous with a small, oblique, dorsal fold; a very narrow longitudinal rodlike brown sclerite ventrally. Section "b" oblong, geniculate, with a wide brown laterodorsal sclerite; a row of indistinct dark dots near the dorsal margin; these dots are more numerous in the basal part; the geniculate part of the sclerite is forked, each prong of the fork very narrow, brown and with a dark longitudinal stripe; the claw attached to the prongs; setae on the sclerite as follows (Figure 532): 2 brown, moderately thick dorsodistal setae above the prongs near the bend, which are the longest setae of the sclerite; a thin yellow subapical dorsal seta of moderate length, which is much shorter and thinner than the apical setae; 5 setae on the lateral surface, which are similar to the distodorsal setae but shorter; subapical part sometimes with an additional shorter seta among several other setae;* a long ventral seta situated on a membrane near the margin of the sclerite, slightly distal to the middle. Sclerites "c" form brown trapezoidal plates and a small rounded plate with a short strong brown seta in the geniculate part on the ventral side.

Claws broad at the base (Figure 532), dark, hook-shaped, pointed; membranous transverse stripe of claw distinct; the dark brown, thick seta 1 situated at the boundary of the basal and apical parts on the dorsal side; this seta is the longest seta of the claw; seta 2 situated lateral to this seta on the outside; median seta 3 situated slightly more distally; both setae thin, light brown, shorter than seta 1; the basal, relatively thick, reddish brown seta 4 is situated on the median side of the claw near the membranous stripe; the thin brown seta 6 is situated in the distal part on the outer side; ventral seta 7 and 8 almost transparent, long, slightly curved; the small, thin, dark, spinelike seta 5 is situated near seta 8 on the outer side.

**Young larva.** Number of stages probably 5, as in Philopotamidae.

First stage (?). Length 5 mm; head longer than pro- and mesothorax; sutures on head and pronotum absent; periocular area white; other parts of head and pronotum yellowish brown; dots indistinct; legs light, pattern indistinct. Setae of head, especially setae of the frontoclypeus and seta 9 relatively long. Anterior-angle primary setae of pro-
387 notum also long; only 3 primary setae on the sclerite; lateral seta on the

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* The laterodistal setae are easily lost and possibly do not always develop completely; their full number is rarely present in fixed material.

black spot and spot absent. Setae of meso- and metathorax, like the abdominal setae, especially the anterior-angle setae, long; setae of the laterodorsal sclerite of anal legs long.

Second stage (?). Length 10.5–12.5 mm. Head markedly oblong, as broad as the abdominal segments; head and prothorax together about $\frac{1}{4}$ as long as the body. Head sutures and suture of pronotum marked. Pattern distinct on the background of the shining brownish yellow sclerites (as in the full-grown larva); median stripe of frontoclypeus present; dots, spots and stripes indistinct. Setae relatively long. Laterodorsal sclerite of anal legs with only one laterodistal seta in addition to the 2 dorsal setae and the ventral seta.

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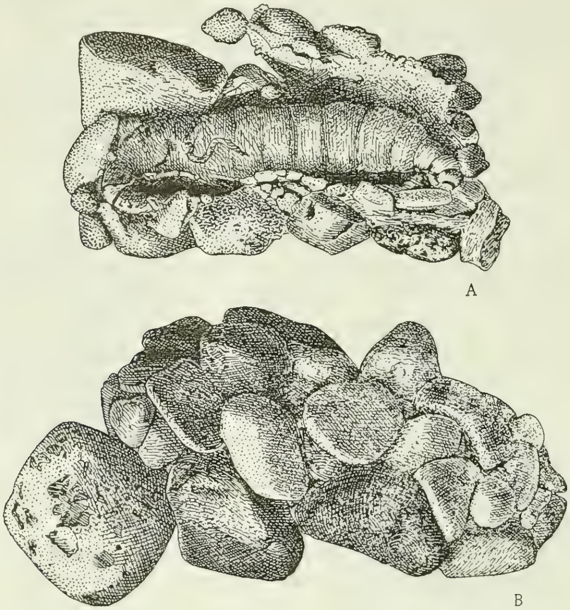


FIGURE 536. Stenopsyche griseipennis McL. Pupal case, ventral (prepupa visible inside) (A) and dorsal (B)

**Pupa.** Length of young pupa 25–26 mm (Figure 533). Antennae long, their ends coiled around the posterior segments; 1st antennal segment large, its setae short and black. Setae of anteclypeus (Figure 534) stituated on small brownish sclerites, 3 on each side; lateral seta yellowish, almost transparent, shorter than the other two reddish brown setae; the intermediate seta slightly longer than the median seta. Labrum as in Philopotamidae, with 3 reddish brown setae at each side of the anterior margin; intermediate seta lighter and median seta longer and thicker than the others. Mandibles long, geniculate, without teeth, with straight, coarsely serrated blade and dark, pointed apex; outer setae present at the base; basal seta straight and dark, reddish brown; a shorter, spinelike transparent seta slightly anterior to it.

Maxillary palps long, 5-segmented; last segment curved and much longer than the others; labial palps 3-segmented; last segment longer than the two preceding segments together (Figure 534). The blunt wing sheaths reach the 4th abdominal segment; hind legs reaching end of body; midlegs reaching segments 5 or 6; claws small, light, brownish at the end; natatorial setae short, light, situated dorsally and ventrally on the first 4 segments of midtarsi, small and sparse on the 4th segment. Presegmental plates present on segments 3—8, small and brown (Figure 535), postsegmental plates on segment 5; number of denticles as follows: III:4—5; IV:6—7; V:7—10 + 10—12; VI:9—10; VII:9—10; VIII:7—8; presegmental plates of segment 8 connected by posteriorly-curved sclerotized fold covered with spinules; a similar, but lower fold in the posterior part of the dorsum of segments 7 and 8. End of body narrow, with two long anal rods with black setae posteriorly; these rods are thick, white and bent ventrally in young pupae.

Pupae lying in elliptical case, which is built solidly of small stones and sand grains; case with numerous ventilation holes (Figure 536); inner wall of case smooth and thick. The pupa lies in a thin, loose cocoon made of sparse grayish threads.

389 Mode of life and habitats. Streams, in foothills, large brooks and rivulets, on pebble bottom; living in tubular tunnels; microphagous.

Distribution. USSR: Altai, Sayans, Maritime Territory, Sakhalin. In addition, Japan, Korea, Mongolia, China, northern India.

### 2. **Stenopsyche bergeri** Martynov

Lepneva and Levanidova, 1953:326—336, Figures 1—8.

**Full-grown larva.** Length 38—40 mm; form of body (Figure 537) as in S. griseipennis; sclerites lighter; ground color yellow or light yellow; punctate pattern more distinct, as the dark background is absent.

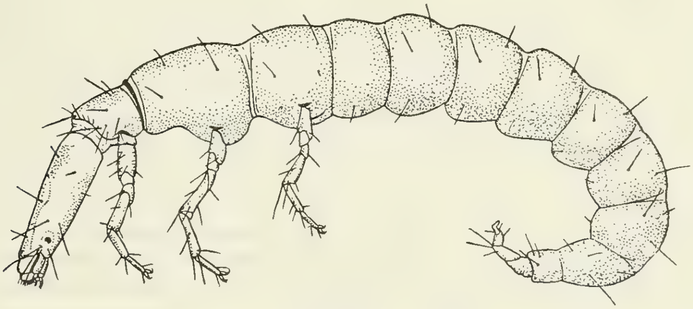


FIGURE 537. Stenopsyche bergeri Mart. Full-grown larva, lateral (after Lepneva and Levanidova)

Head (Figure 538) relatively longer than in S. griseipennis, light yellow; eyes situated on a white area. Frontoclypeus slightly dark in anterior half, brownish yellow, like the large sclerites lateral to it;

mediolongitudinal dark stripe characteristic for S. griseipennis absent in S. bergeri; a large oblique black dot (consisting of 2 or 3 fused smaller dots) near the anterior margin, lateral to the median pit; two large blackish dots near the curvature of the frontal sutures; (390) two small, asymmetrical, oblique dots anterior to these dots, in the middle; a curved row of 3 transverse dashes in the posterior angle of the sclerite; each dash consists of several fused small dots. Dorsal setae of sclerite as in S. griseipennis but darker; lateral anterior-margin and anterior frontal setae light, thin, curved inward, recumbent; other two anterior-margin setae and mediofrontal seta of almost the same length, directed slightly anteriorly, blackish; posterior frontal seta slightly shorter, strong and black. A narrow dark stripe and a dot lateral to the epicranial suture. Short rows and groups of dots (Figure 538) interspersed with small and coarse dots posteriorly, on both sides of the head to the occipital foramen. Dorsal setae situated lateral to the frontal sutures, as in S. griseipennis, but darker. A narrow dark stripe, which is more distinct anteriorly along the gular suture; gula grayish brown. Ventral surface without dots anteriorly except two small dots lateral to the gular suture; short rows of 3—5 dots in the middle; dense groups of dark dots and two large, coarse dots near the gular suture near the occipital foramen. Seta 18 short, spinelike, black; a dark spot at its base absent.

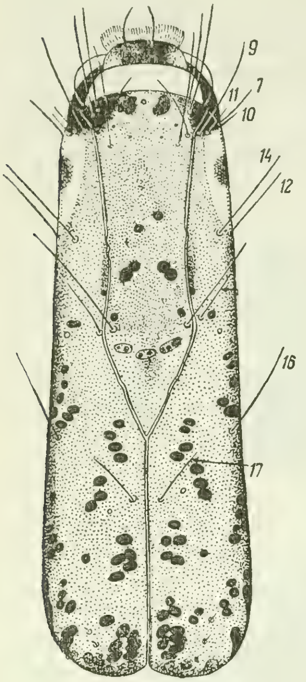


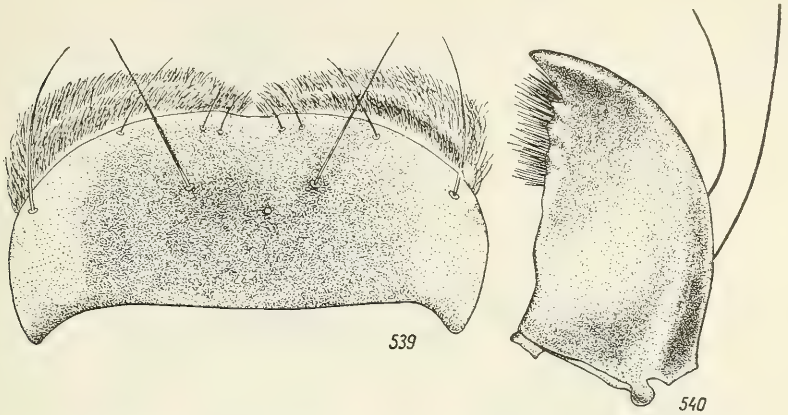
FIGURE 538. Stenopsyche bergeri Mart. Head, dorsal (after Lepneva and Levanidova)

Anteclypeus whitish, with four broad, longitudinal, light yellow stripes. Labrum (Figure 539) as in S. griseipennis, with a narrow membranous margin and a brush of straight, dense hairs near the anterior margin; dorsal sclerite black in the greater part of the middle and posteriorly at the sides; a yellow space in form of light spots present only near the anterior angles; an asymmetrical median pit prominent as a small light dot on the black background; two yellow dots one behind the other near the posterior margin of the sclerite; setae 5 and 6 situated on light dots; longer than the others, brownish black, very thin at the end; seta 3 situated near the anterior margin, not very distinct; setae 2 and 4 situated close together near the median process, small, transparent and situated on light dots.

390 Left mandible (Figure 540) as in S. griseipennis, with little developed upper blade; it does not have 1 intermediate tooth as S. griseipennis but 2 intermediate teeth, one of them smaller than the other; upper blade without teeth, except the apical tooth, lower blade with 3 teeth; chetoids in median depression shining, light yellow. Right mandible with 2 large apical teeth; upper blade also with a small tooth and lower blade with 2 teeth;

these teeth separated by space with a third blunt, short tooth. Outer setae of mandibles almost of same length; basal seta slightly curved and brown, second seta situated further apically, yellowish, light and strongly curved.

(391)



FIGURES 539 and 540. Stenopsyche bergeri Mart. (after Lepneva and Levanidova): 539 – labrum; 540 – left mandible, ventral.

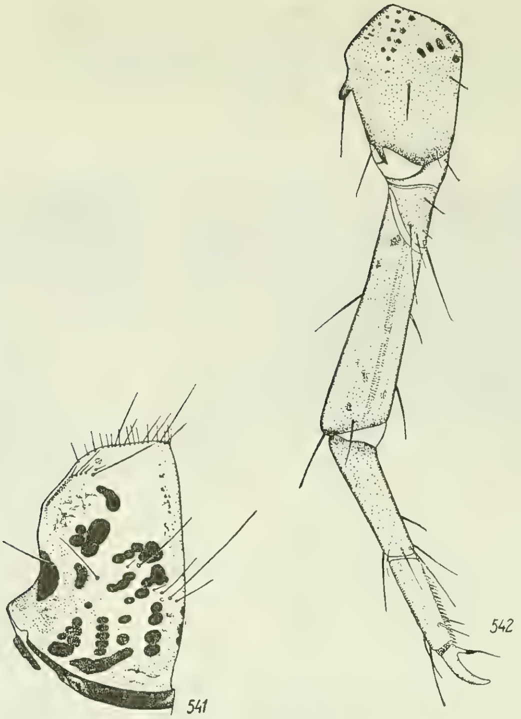
Maxillolabium as in S. griseipennis; black and dark brown sclerites more distinct on background of white or yellow membranous areas. Submentum brown at the base and laterally; other part of sclerite, including anterior rounded process, brownish black; setae reddish brown; sclerites of cardo, stipes and palpifer shining black in their greater part; their setae blackish brown; hairs of galea yellow and reddish yellow. Sclerite of first palp segment yellowish brown; sclerites of other segments dark brown. Mentum dark brown. Ventral sclerites, sclerites of labial palpifer and labial palps distinct, light brown.

Pronotum (Figure 541) light yellow, with broad black posterior margin and large black spot in the middle of the lateral margin; anterior angle with a narrow dark brown stripe; posterior angle of sclerite as in S. griseipennis, curved ventrally. Dots shown in Figure 541. Setae as in S. griseipennis but darker; long anterior-margin setae blackish brown; thick surface setae black.

Propleuron light yellow, of the same form as in S. griseipennis, with a narrower median and posterior margin in the ventral part; horn-shaped process of trochantin light yellow, brownish at the base, with 2 small, thin, light subapical setules; a small brownish seta further basally; epimeral seta short and brown; pleural suture narrow, blackish brown.

Sternite of prothorax as in S. griseipennis, black, its median part narrower and divided near the anterior margin; posterior-angle processes more strongly curved.

Form and coloration of meso- and metathorax and their setae similar in both species. The black rodlike sclerites of the pleuron, which are bordered with brown, and their setae also similar; episternal part slightly longer and narrower in S. bergeri than in S. griseipennis.



FIGURES 541 and 542. Stenopsyche bergeri Mart. (after Lepneva and Levanidova):

541 – pronotum; 542 – right foreleg, anterior.

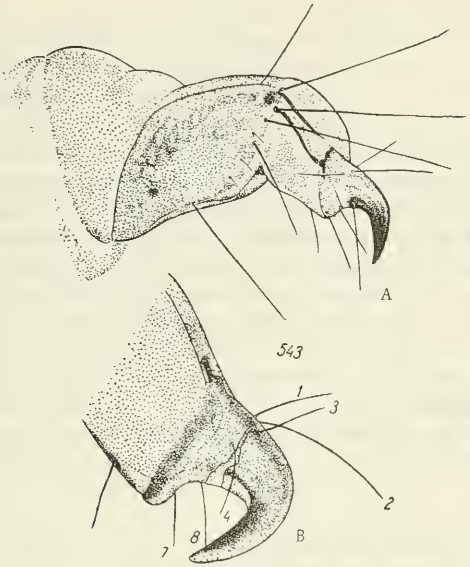
Legs yellow or light yellow; dots on coxae brownish black; those on femora brown, light brown and indistinct in some places. Legs of both species similar in length and form of the segments. Coxae of forelegs an exception, as their dorsal processes vary strongly. Instead of the long, broadly conical, basal process of the coxa of the forelegs of S. griseipennis, S. bergeri has a small process with a rounded apex in the middle of the segment (Figure 542); this process bears a black subapical seta, which is longer than in S. griseipennis; apicodorsal process longer than basal process; seta at its apex small but distinct, not as short as in S. griseipennis. Pattern and setae of legs of both species similar; some setae longer and darker in S. bergeri than in S. griseipennis, and almost black. Spinules of combs of fore tarsi shining, yellowish brown, whitish yellow and longer on the tarsi of the midlegs and hind legs; claws similar; a light seta on the basal process present only on the forelegs.

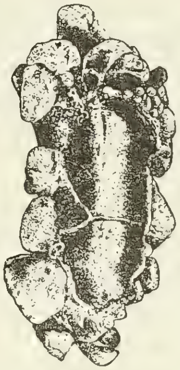
Abdominal segments and their coloration and setae as in S. griseipennis.

391 Anal legs of both species similar in general form; sclerites and setae have similar characteristics. Dorsolateral sclerite of anal legs of S. bergeri (Figure 543) yellow; stripe consisting of fused dots grayish brown, the stripe parallel to it indistinct; rodlike sclerites of fork of geniculate part narrow, yellow, with a black longitudinal stripe. Short

subapical seta brownish black; both distodorsal setae black, stronger and thicker than in S. griseipennis; 2 laterodistal setae, which are black or brownish black, and slightly shorter and thinner than the distodorsal setae; 3–4 small brown setae near them (1–2 between them and 2 more ventrally); 3 long laterodistal setae in some specimens; ventral seta situated on a membrane near the margin of the sclerite black, thick and slightly shorter than the dorsal setae. The trapezoidal round sclerites "c" are reddish brown; its seta slightly longer than in S. griseipennis, dark and strong.

(392)





FIGURES 543 and 544. Stenopsyche bergeri Mart.:

543 – anal legs: left anal leg, outer view (A – after Lepneva and Levanidova); right claw, inner view (B); 544 – pupa in its case, ventral (after Lepneva and Levanidova).

Claw (Figure 543, B) slightly lighter than in S. griseipennis; its end reddish brown, its base yellowish brown; setae similar, slightly differing in length and color; dorsal seta 1 brown, longer and thicker than the others; the thin setae 2 and 3 much shorter than seta 1 and light brown; seta 6 light brown and straight; median seta 4 situated near the basal margin of the transverse stripe, dark brown and strong, ventral setae 7 and 8 transparent, long, slightly curved; small, light seta 5 near them, thin and spinelike.

**Pupa.** Length of old pupa 18–20 mm. Antennae longer than body, but not coiled around the end of the body in old pupae. First antennal segment with 9 long blackish brown setae and several short setae near the base. Setae of clypeus situated on a yellowish sclerite, which is not as distinct as in S. griseipennis. Lateral seta of young pupae almost transparent; light brown in old pupae; other setae dark brown, almost black. Setae of labrum dark brown, 3 on each side of the anterior margin; median seta blackish and strong, slightly longer than the others. Mandibles reddish brown, with slightly curved blackish brown end; blade as in S. griseipennis, straight and serrated; outer dark basal seta longer than in S. griseipennis, markedly longer than the distance from the basal margin to the seta; a transparent seta near the basal seta; it is more than half as long as this and not shorter as in S. griseipennis.

Wing sheaths reaching segment 5 of the abdomen. Natatorial setae situated dorsally and ventrally on segments 1–4 of mid-tarsi short and light, sparse on the 4th segment; claws brownish.

Presegmental plates present on abdominal segments 3–8; postsegmental plates on segment 5. Number of spinules as follows: III:4; IV:5; V:6–5 + 8–9; VI:8–9; VII:9; VIII:7; denticles and plates reddish brown, lighter than in S. griseipennis. Sclerites of segment 8 connected by a high, dark, sclerotized fold with small spinules in a comb; a lower, posteriorly-curved yellowish sclerotized fold near the posterior margin of the segment. A similar fold near the posterior margin of segment 8.

393 End of body with two long anal rods with 20–25 strong black hooklike setae. Anal appendages of young pupae broad, white, curved ventrally. The imaginal characters (spurs of legs, genital appendages) are distinctly visible through the integument in old pupae and are reliable characters for identification of the species. Pupal case (Figure 544) as in S. griseipennis.

Mode of life and habitats. On stony bottom (mainly pebble bottom) of streams and rivulets.

Distribution. USSR: Maritime Territory. In addition, Japan, Korea.

## VI. Family PSYCHOMYIIDAE Kolenati

**Full-grown larva.** Length 4.5–11.0 mm. Anterior-margin setae of frontoclypeus long, situated near the angle, close to each other; median frontal seta as long as posterior frontal seta. Median depression of left mandible with a dense brush of chetoids; outer setae of mandible situated close together, almost of the same length. Labial lobe long, ligula thin, extending beyond the maxillary palps or reaching to their end; labial palps absent. Only pronotum sclerotized. Meso- and metanotum broader than pronotum. Setae at anterior margin of pronotum equally spaced.

Propleuron of a characteristic form; epimeron less well developed than episternum; trochantin with a dark broad leaf-shaped distal process.

Forelegs more massive and longer than midlegs and hind legs; articular process of basal margin of coxa dark brown, conical; claws curved, with a process near the base of the seta.

Anal legs moderately long; section "a" short, much smaller than section "b"; 7–8 dorsal setae on section "b", concentrated near the distal margin.

Claw without a ventral comb of spinules, replaced in some species by several small denticles or larger isolated spines.

**Pupa.** Length 4.2–5.5 mm. Labrum short, semicircular anteriorly with 5 setae concentrated near the anterior angles. Mandibles long, their median part narrow; their end prolonged in a filament, which is curved and sometimes bifid near the apex. Number of spurs 2, 4, 4. Presegmental plates on segments 2–8 and postsegmental plates on segment 5. Lobes of the last segment with 7 or 8–9 setae at the end.

Mode of life and habitats. Running water with rapid or slow current; also in the open littoral of large lakes.

Distribution. Throughout the Soviet Union. In addition, cosmopolitan, except Australia and New Zealand.

### Key to Genera

Full-grown larva

1 (2). Head and pronotum yellow or yellowish brown, with light brown or indistinct pattern, or without pattern. Gula small, forming an equilateral triangle wedged into the anterior margin of the head. Submentum blackish, dark brown or reddish brown, pentagonal, with a rough, tuberculate surface and a light, long median suture; each half of sclerite longer than broad. Claw of anal legs with several long coarse ventral spinules . . . . . . . 3. **Psychomyia** Latr. (p. 455)

2 (1). Head and pronotum with distinct pattern or dark and without pattern; gula broadly triangular, situated outside the head capsule. Submentum light, dark only laterally, short and broad, with a median suture; each half of sclerite much wider than long. Claw of anal legs with a few ventral small spinules or without spinules.

3 (4). Head with slightly dark dorsal stripes or dark. Mandibles in the greater part long . . . . . . . . . . . . . . . . . 1. **Tinodes** Curt. (p. 441)

4 (3). Head light, with a broad transverse dark band posteriorly, which is continuous or interrupted on the frontal sclerite. Mandibles massive and short . . . . . . . . . . . . . . . . . 2. **Lype** McL. (p. 450)

394 Pupa

1 (4). End of mandibles hooklike, divided; blade of mandible straight in its middle serrated part.

2 (3). Length 4.2–4.4 mm; presegmental spinules in small numbers: 5–6 on segment 4, 6–8 on 6, 4–5 on 8. Anal lobes broad, short and with 7 terminal setae . . . . . . . . . . . . . 1. **Tinodes** Curt. (p. 441)

3 (2). Length 5.5 mm; presegmental spinules more numerous: 7–9 on segment 4, 12–13 on 6, 8–11 on 8. Anal lobes narrow, long, with 8 setae . . . . . . . . . . . . . . . . . . . . . . . . . 3. **Lype** McL. (p. 450)

4 (1). End of mandible undulately or spirally coiled, pointed; blade of mandible slightly convex in the middle serrated part . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Psychomyia** Latr. (p. 455)

### 1. Genus **Tinodes** Curtis

**Full-grown larva.** Length 8–10 mm. Head oblong, with almost parallel sides. Frontoclypeus with straight anterior margin, with a transverse row of 3–5 light dots posteriorly; the lateral dot at the base of the long posterior frontal setae. Mandibles long, massive, with a large molar tooth at the base. Submentum short and broad, with a median suture, brown. Ligula narrow, usually longer than the maxillary palps.

Pronotum dark or with a pattern of stripes and spots.

Sclerite of section "b" of anal legs with 5–7 long apical setae and a short subapical seta. Claw with a few small ventral spinules or without spinules.

**Pupa.** Length 4.3–5.0 mm. Antennae long, reaching the last segments of the abdomen or the end of the body. Blades of mandibles finely serrated in the middle, straight; the filiform apical process hooklike at the end, and divided into 4–6 denticles. Presegmental plates on segments 2–8 with a few spinules; postsegmental plates on segment 5, with more numerous spinules. Lobes at end of body relatively short, with several long setae.

Case made of loose tissue with a covering of sand grains, with numerous filtering holes at each end;* these holes are situated on the ventral side anteriorly; they are situated slightly more dorsally posteriorly; length of case 5.5–7.5 mm.

Mode of life and habitats. Running water of various types; some species occur in lakes.

Distribution. West and northwest of the European USSR: the Crimea, the Caucasus, Transcaucasia; Middle Asia. In addition, Europe, North and Central Africa; Asia Minor, Iran, Pakistan; India; Sunda Islands; Taiwan; Japan; North and South America.

Key to Species

Full-grown larva

1 (2). Three large light dots posterior to the frontoclypeus. Upper blade of left mandible with one large tooth; lower blade without teeth. One large light dot on each side of the gular suture . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. **T. pallidula** McL. (p. 449)

2 (1). Three to five light dots posterior to the frontoclypeus. Upper blade of left mandible with 2 or 3 teeth; lower blade with teeth. One dark and one light dot on each side of the gular suture; several dots near the occipital foramen.**

3 (4). Frontoclypeus with 4 or 5 large light dots posteriorly. Upper blade of left mandible with 2 or 3 teeth; lower blade with 2 teeth; right mandible with curved distal part with a shallow median depression. Propleuron without dots . . . . . . . . . . . . . 1. **T. waeneri** L. (p. 443)

4 (3). Frontoclypeus with 3 large light dots posteriorly. Upper blade of left mandible with indistinct teeth; right mandible with one blade. Propleuron with 5 light dots . . . . . . . . 2. **T. rostocki** McL. (p. 447)

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* The filtering nets of the pupa were first observed by Morton (1890a:39) in Tinodes waeneri; they were illustrated for Tinodes sp. by Thienemann (1905b:Plate 18, Figures 88 and 89).

** Bracket No. 2 applies to T. waeneri, for I did not see larvae of T. rostocki.

395 **1. Tinodes waeneri** Linné

Morton, 1890a:38—42, Figures 6, 7.— Ulmer, 1903:123, Figure 44.— Siltala, 1905:135—138, Figure 36.— Ulmer, 1909:233, Figure 357a.— Lestage, 1921:516—523, Figure 172.— Lepneva, 1940:203.— Hickin, 1950:67—70, Figures 1—12.— Lepneva, 1956:21—25, Figures 4, 10, 16, 19, 22, 25, 28, 34.

**Full-grown larva.** Length 8—10 mm; sclerites yellowish; pattern grayish or reddish brown; setae thin, weak, brown, brownish yellow or light. Head markedly longer than broad, with almost parallel sides; light periocular field large; antennae with one relatively long seta and 2 short setae. Frontoclypeus with straight anterior margin, brownish, dark brown posteriorly, with a transverse row of 4 or 5 light dots. Dorsal stripes short, brown, with large light and dark dots; a narrow light space between the dorsal stripes and the epicranial suture; isolated dots instead of the lateral stripes; Anterior-margin setae long, thin, displaced to the anterior angles; lateral seta lighter than the others, slightly curved inward; anterior frontal seta short, transparent, recumbent; middle seta situated in the anterior part of the sclerite, posterior seta in its broad part; both setae long, thin and brown; the light spots at the base of these setae are the lateral dots of the transverse row. Seta 7 moderately long, situated near the anterior margin; seta 9 situated medial to the eye, long and brown, the small light setae 11 situated near it; the small, light seta 10 situated lateral to the eye; the thin, long, brown setae 12 and 14 and the small light seta 13 situated posterior to the eye; setae 15 and 16 small, situated near seta 13; seta 17 situated near the bifurcation of the frontal sutures, small, spinelike, yellowish and curved posteriorly. A narrow dark stripe ventrally, along the gular suture; middle of head with a light and a dark dot; indistinct light dots near the occipital foramen; seta 8 situated near the anterior margin, small and spinelike.

Anteclypeus oblong, tapering anteriorly, light; its broad longitudinal stripes indistinct and pale.

Labrum (Figure 545) small and short, with rounded anterior angles; anterior part of dorsal sclerite indented in the middle, brownish yellow, brown posteriorly, dark with brown spots near the posterior angles; posterior-angle sclerites rodlike, dark and slightly curved; median depression of the membranous anterior margin shallow, with short straight hairs; sides of anterior margin and sides of labrum with longer hairs. Seta 1 small, transparent, situated among the hairs; setae 4 spinelike, situated at the margin of median indentation; setae 6 situated posterior to them; setae 2, 3 and 5 relatively thick and light brown, situated at the sides of the sclerite.*

Mandibles long, massive, more than half as long as head; apical tooth broad, bluntly rounded. Left mandible with a deep median indentation; upper blade of left mandible with 2, sometimes 3 teeth near the distal margin; two tubercles in the middle; lower blade with 2 teeth; chetoids of penicillus in the median depression of varying length; the mandibles have a small groove on the outer side near the base; outer setae situated in about the middle of the mandible; apical part of right mandible with slightly concave median surface; upper blade with 2 blunt indistinct teeth; lower blade (sometimes also upper blade) without teeth; mandible with a tuberculate molar tooth near the base; outer side of mandible slightly grooved; outer setae situated near the dorsal margin, of the same length.

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* The cover of dense short hairs shown by Hickin (1950:67, Figure 5) is absent on the dorsal surface of the labrum; Morton (1890a, Figure 7), Klapálek (1893, Figure 1) and Siltala (1905) also do not show these hairs for species of Tinodes.

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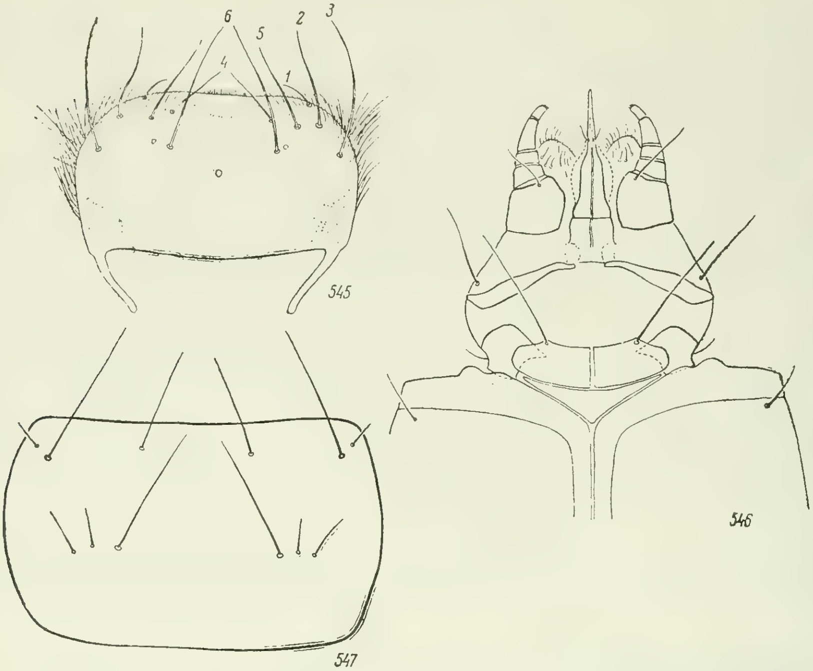

FIGURES 545–547. Tinodes waeneri L.:

545 – labrum; 546 – part of head, ventral, gula and maxillolabium; 547 – mesonotum.

Maxillolabium (Figure 546) oblong, narrower anteriorly. Submentum with 2 transverse sclerites; seta near anterior margin long and light; cardo dark; seta small and thin; stipes brown and rodlike; outer seta long, situated on a membrane, distal seta smaller; palpifer very broad; seta near the distal margin of the sclerite dark; 1st palpal segment slightly longer than 2nd segment; 3rd segment the longest; 4th segment small and narrow; sensillae distinct; galea rounded apically, with numerous hairs; setae and sensillae large. Mentum covered by the fold of the submentum at the base; labial lobe narrow, prolonged into a long, narrow ligula, which is curved ventrally; 2 small light setae near the base of the ligula at the place of the
396 ventral sclerites; labial palps absent.

Pronotum brownish yellow, its anterior margin light yellow; anterior angles rounded, posterior margin thick, darkish brown, bordered by a shallow groove; a large dark spot laterally at the point of articulation with the pleuron; posterior angle curved ventrally, contiguous with the narrow rodlike sternites, which form a small, pointed light process in the middle.

A narrow dark stripe dorsally along the median suture; a large elliptical dark spot on each side near the posterior margin; an inward-curved, grayish brown stripe with large dark dots in the middle of each half of the sclerite; primary anterior-angle seta brown, long; lateral margin with 2 small, strong, dark setae posterior to it; 8 brown anterior-margin setae equidistant from each other; 4 of them almost as long as the anterior-angle seta, the others distributed among the long setae, moderately long or short; primary anterior-margin seta near the suture long, brown, situated in the anterior half of the sclerite; 2 smaller and thinner dark setae posterior to it in the middle (medioanal and intermediate seta) situated on the curved dark stripe; lateral surface seta near the outer margin of the stripe of the same length; a small light secondary seta near it; a long brown seta near the anterior margin of the dark lateral spot.

Meso- (Figure 547) and metathorax broader than prothorax, pinkish brown, with a delicate pattern of white stripes and spots; these segments and abdomen greenish in some larvae. Anterior-margin, anterior-angle and medioanal setae of the above segments thin and relatively long; the thin, short intermediate seta and the lateral seta situated near the medioanal setae.

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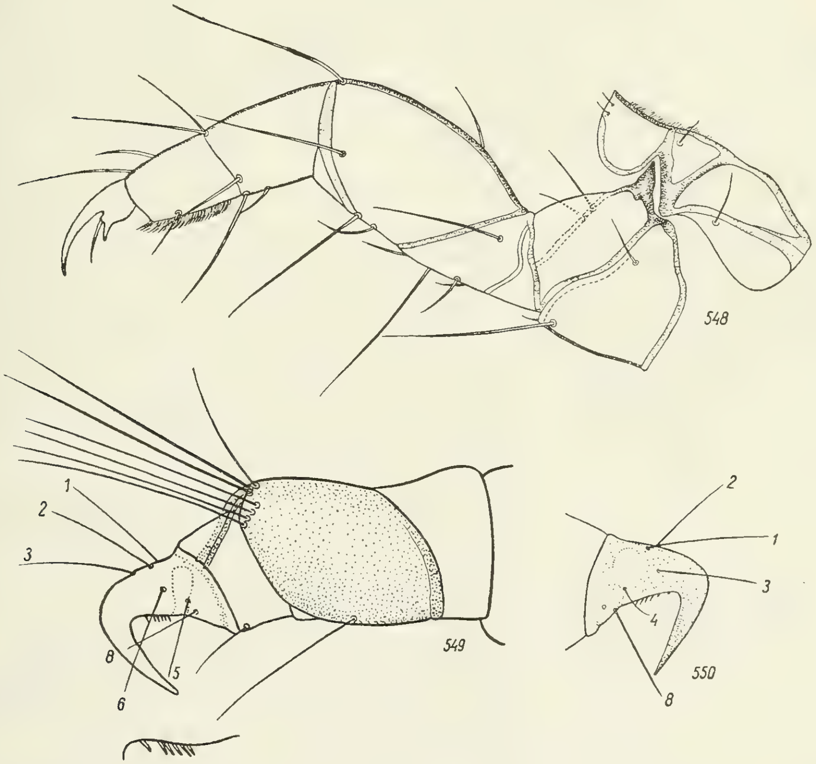

FIGURES 548–550. Tinodes waeneri L.:

548 – propleuron and foreleg, posterior; 549 – right anal leg, outer view; 550 – claw of anal leg, inner view.

Propleuron (Figure 548) very wide; pleural suture clearly marked, dark brown; epimeron larger than the episternum; its seta situated near the pleural suture. Trochantin large, divided into a basal triangular part surrounded by short dark ridges and a pointed apical lobe-shaped part; 2 small setules at the anterior margin near the angle; a row of short, dark, thin spinules further basally; a seta in the basal part near the ridge.

Meso- and metapleuron with a narrow reddish brown pleural suture; episternum and epimeron thin, pale yellow, narrow, indistinct; seta of epimeron situated in the middle near the margin of the sclerite; small, thin and dark; seta of episternum similar.

Legs relatively short; forelegs slightly longer and stronger than midlegs and hind legs; legs without dots; only primary setae present, which are brown, light brown or light.

Coxae of forelegs (Figure 548) short, massive, with a deep distodorsal indentation; articular process at basal margin large, broad, conical. Anterodorsal setae situated close together; basal seta longer than apical seta; posterodorsal seta slightly curved, situated at a distance from the margin; one of the 2 anterior setae as long as the distodorsal seta and situated near it; the other smaller and situated ventral to it; the posterior of the 2 distoventral setae, thin and relatively long; the anterior seta small
398 and curved. Trochanter very wide, with a distinct basal suture; anterior seta strong, spinelike; posterior seta thin, relatively long; one of the two posteroventral setae situated in the middle, spinelike, the other situated subapically, long and brown; it is one of the longest setae of the leg; seta near the suture of the 3 anteroventral setae spinelike, light, curved distally; distal seta similar; third ventral seta not visible in my preparations.

Femur slightly convex dorsally, straight ventrally, shorter than the ventral margin of the trochanter; anterior seta of femur situated subapically, short, curved, spinelike; posterior seta long, thin and brown; distodorsal seta thin and long; basodorsal seta spinelike, slightly curved, light; apicoventral seta long, subapical seta short, curved and spinelike.

Tibia massive, short and straight; both dorsal setae of tibia situated near the apex; anterior seta shorter and thinner, posterior seta almost as long as that of the femur; anterior seta straight, moderately long; posterior seta situated close to the apicoventral seta, straight and long; subapical ventral seta spinelike.

Tarsus slightly shorter than tibia, narrower apically, with a comb of dense, thin spinules ventrally; apicodorsal seta dark, long; subapical seta short, slightly curved; both ventral spinelike setae situated subapically on each side of the comb. Claw curved, blunt, with a blunt, massive, basal spine; a transparent, spinelike basal seta near the spine.

Mid- and hind coxae with a short ventral and posterior surface and well-developed anterior and dorsal surface; distodorsal indentation deep; basal articular process not as massive as on the forelegs. Both anterodorsal setae widely separated; basal seta shorter than apical seta in the middle of the segment; posterodorsal seta situated near the distal margin; one of the anterior setae situated near the dorsal setae; second seta situated further ventrally; anterior ventrodistal seta small, light; posterior seta long. Anterior seta of trochanter as on the forelegs; posterior seta shorter and thinner; one of the 2 posteroventral setae situated subapically, long and dark, the second in the middle of the segment and spinelike; one of the anteroventral setae situated near the suture, the other apically; both are spinelike, slightly curved; third seta not marked. Femur short, with broad base and narrow apex; setae as on the forelegs. Tibia broader apically than basally; apicodorsal seta long and dark, subapical seta shorter and light; anterior and posterior setae almost of the same length; both ventral setae small and spinelike, situated distally close together. Tarsus narrower distally; dorsal setae thin, almost of the same length, situated apically and subapically; ventral row of spinules absent except 2 small, strong distal spinules situated between the distoventral setae; the posterior of these setae flattened, broadened like a leaf; anterior seta thin, light and feathered; both setae small. Claw as on the forelegs, with a blunt basal spine and a pointed transparent seta at its base.

Abdominal segments colored like meso- and metathorax; first segment much smaller than the others; segments 2 and 3 also slightly shorter than the following segments. Medioanal seta relatively long; the thin, light, poorly visible intermediate and lateral seta, which are longer on the posterior segments, situated near it. Anterior-angle seta slightly shorter and thinner than medioanal seta; longer on segments 7 and 8 than on the anterior segments and displaced to the posterior half of the segment. Anterior-margin setae small and light.* One ventral seta in each half of the segment; they are well developed on segments 2—8 and project ventrally; they are short and light, not always marked on segment 1.

Medioanal seta of segment 9 strong, dark reddish brown, long intermediate seta small, thin, larger than on the preceding segments; lateral seta small; sides with a strong dark anterior-angle seta posteriorly; ventral setae as on segment 8.

Section "a" of anal legs short (Figure 549); sclerite of section "b" with a group of 7 blackish brown setae distally, 2 of them thick and long, situated near the base of the dark plates of the geniculate bend; 4 thick and long setae situated close together near them on the outer side; a short, dark seta, which is slightly curved posteriorly above the former setae; a long straight dark
399 seta on the outer side, in about the middle of the ventral margin. A straight, light, moderately long, strong seta on the sclerite of section "c."

Claw (Figure 550) dark brown, with spinules ventrally; setae 1 and 2 of the same length; the similar seta 3 situated distally in the middle; seta 6 situated in the distal part on the outer side; seta 5 situated near the margin of the basal part of the claw; seta 4 situated on a membrane; seta 8 straight and strong, light brown, reaching the end of the claw.

Mode of life and habitats. Larvae free-living, building galleries of loose tissue on various objects; these galleries are 40—50 mm long; they are detritophagous and occur mainly in lakes, in the calm littoral with weak surf, often in estuarine zones and in slow rivulets, in plant thickets and near the banks.

Distribution. European USSR. In addition, Europe.

### 2. **Tinodes rostocki** McLachlan

Klapálek, 1893:122—125, Figure 33.— Ulmer, 1903:122; 1909:233, 299, Figure 434.— Lestage, 1921:518, Figure 172, c, f, m.

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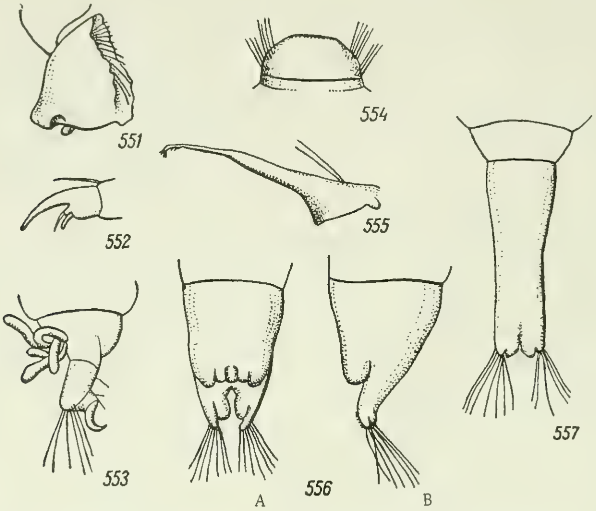
* Visible in microscopical preparations.

**Full-grown larva.** Length 9–11 (?) mm. Head as in T. waeneri, slightly oblong; ground color light brown; frontoclypeus dark brown, a transverse row of 3 light dots in the posterior part. Dorsal stripes represented by a row of dark and light dots that reach the occipital foramen.



FIGURES 551–557. Tinodes rostocki McL. (after Klapálek):

551 – left mandible, dorsal; 552 – distal end of tarsus and claw of foreleg; 553 – right anal leg, outer view; 554 – labrum of pupa; 555 – left mandible of pupa, ventral; 556 – end of body of male pupa, ventral (A) and lateral (B); 557 – end of body of female pupa, ventral.

Labrum broad, with slightly concave anterior margin; seta 6 further away from anterior margin than in T. waeneri.* Left mandible (Figure 551) with 2 indistinct blunt teeth on the upper and lower blade; median depression with numerous short and long chetoids. Right mandible with 1 blade with 2 indistinct teeth in addition to the apical tooth. Outer
400 setae situated in about the middle of mandible, close together and almost of the same length. Ligula markedly longer than maxillary palps.

Pronotum brownish; a large dot lateral to the median suture, in the middle; each half of sclerite with numerous light dots. Setae at anterior margin yellowish brown; surface setae relatively short. Propleuron with 5 light dots. Legs, especially claws (Figure 552) as in Tinodes waeneri.

Sclerite of segment "b" of anal legs with 6 straight, long setae at the apex (Figure 553); ventral seta short.

**Pupa.** Length 4.3–4.4 mm. Antennae of male pupae reaching anterior margin of segment 9, of female pupae end of abdomen. Three almost equally long setae close together near posterior angles of anteclypeus. Labrum (Figure 554) broad and short, with rounded anterior margin;

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* Klapálek (1893, Figure 33, 1) and Lestage (1921:518, 172, c) erroneously show an additional pair of setae lateral to seta 6 (supposedly setae 7 and 8) in their drawing.

anterior angles indistinct, with 5 dark setae situated close together on each side of labrum. Mandibles (Figure 555) with broad base, a long middle part and apex prolonged in a filament; apex hooklike, divided into 4 denticles; 2 small subapical spinules and an indistinct subapical denticle; outer setae straight, short, situated close together, almost of the same length.

Wing sheaths pointed, reaching end of abdominal segment 5, in male pupae, end of segment 6 in female pupae. Natatorial setae on mid-tarsi yellowish brown.

Presegmental plates present on abdominal segments 2–8, postsegmental plates on segment 5; presegmental plates small; spinules on them few, numbers as follows: II:4–5; III:5–6; IV:5–6; V:6–5; VI:6–8; VII:5–6; VIII:4–5; postsegmental plates thin, transverse; large and small spinules forming combs and directed anteriorly near their posterior margin; spinules 18–20 (rarely 12–13) in number. Last abdominal segment of male pupae with two long lobes (Figure 556); each lobe divided into a longer outer part with 7 setae, and a shorter inner broader part with small spinules; last segment of female pupa long, slightly flattened at the end, divided into 2 short lobes; each lobe with 2 apical processes, a shorter outer process with 7 setae and a longer inner process with fine spinules (Figure 557).

Pupal case made of loose tissue and covered with fine sand grains; case 5.5–6.0 mm long.

Mode of life and habitats. The larvae build tunnel-shaped galleries; they are detritophagous and live in rapid rivulets, on stones.

Distribution. USSR: western boundary area. In addition, Central and southern Europe.

### 3. **Tinodes pallidula** McLachlan

Hickin, 1950:103–106, Figures 1–9.

**Full-grown larva.** Length 8 mm, breadth 1.4 mm. Head (Figure 558) shorter and broader than in the preceding species, mainly dark brown; eyes situated on a wide light area. Frontoclypeus dark brown, slightly darker posteriorly, with 3 light dots. Head dark brown posteriorly and ventrally on both sides of the epicranial suture, except on a small anterior stripe; a large light dot lateral to the gular suture. Setae as in T. waeneri.

Labrum yellowish brown dorsally, with dark spots near the posterior angles; setae 2 and 5 situated farther from the anterior margin than in T. waeneri.

Left mandible, with a broad blunt tooth, in addition to apical tooth of upper blade; distal margin of lower blade projecting; median depression with a row of short and long chetoids; right mandible with coarse serrations on the blade; molar tooth of left mandible larger than that of right mandible; basal outer seta longer than the other (Figure 559).

Submentum shorter and broader than in T. waeneri; ligula less long (Figure 560).

Pronotum (Figure 561) dark brown; surface setae nearest to the median suture situated on light dots. Meso- and metathorax, setae and pleural sclerites and legs as in the preceding species.

Anal legs slightly shorter than in T. waeneri. Hickin (1950:105) gives 8 distodorsal setae, one of them short; claw without ventral spinules.

**Pupa.** Pupal case situated in the distal, broad part of the tubular tunnel; walls thick, built of fine sand grains, ventral surface open; pupae lying in a cocoon of loose tissue.

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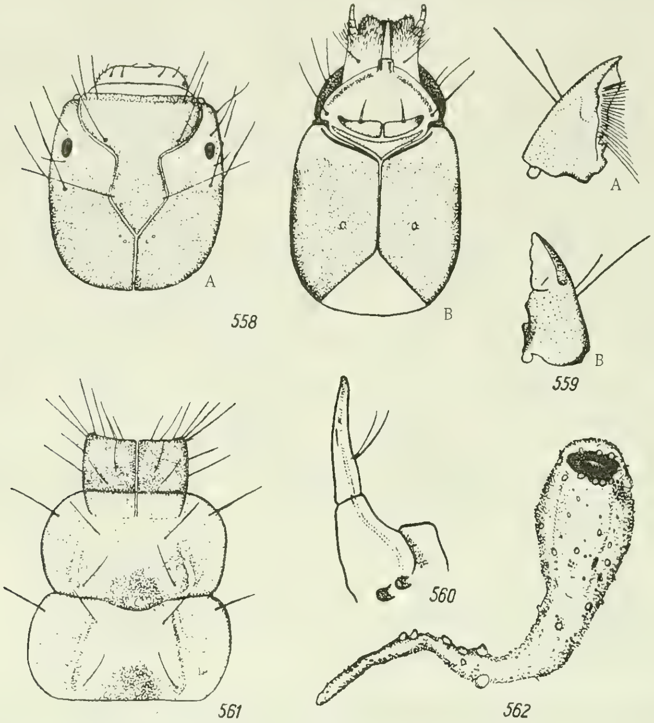

FIGURES 558–562. Tinodes pallidula McL. (after Hickin):

558 – head dorsal (A) and ventral (B); 559 – left mandible, dorsal (A), right mandible, inner dorsal view;(B); 560 – labium, lateral; 561 – thoracic segments, dorsal; 562 – tubular tunnel of larva and pupal chamber.

Mode of life and habitats. Larvae living in tubular tunnels (Figure 562) made of loose tissue, covered with fine sand grains or silt; anterior end of case broad. Detrito- and microphagous. Living in slow brooks and rivulets, especially in ravines.

Distribution. USSR: Petrokrepost'. In addition, Central and southern Europe.

## 2. Genus **Lype** McLachlan

**Full-grown larva.** Length 8–11 mm. Head short and broad. Frontoclypeus with straight anterior margin; posterior frontal seta longer than the middle setae. Posterior half of head with a broad dark transverse stripe, or this stripe interrupted on the frontoclypeus. Mandibles short and massive; outer setae not situated in the middle of the mandible as in Tinodes but nearer the basal margin. Ligula of labium longer than maxillary palps. Pronotum dark except for a light stripe at the anterior margin; light dots in the anterior part of the base of the setae. Anal legs with 6 long apical setae and a short subapical seta; claw without ventral spinules.

**Pupa.** Mandibles with straight, serrated middle part of the blade and hooklike apex. Spurs of fore and mid-tibiae pointed, spurs of hind tibiae
402 blunt. Presegmental plates present on segments 2—8. Last body segment deeply divided, with long, tapering lobes with 8 stiff apical setae.

Mode of life and habitats. Running water, living in long tubular tunnels of loose tissue.

Distribution. European USSR: northwest, west and central region. In addition, Europe, Africa (rare), Iran.

Key to Species

Full-grown larva

1 (2). Frontoclypeus brownish, with a transverse row of 3 dark brown dots; narrow dark stripes lateral to the sclerite, which are contiguous with the fused dark dorsal and lateral stripes; area lateral to the coronal suture, near the bifurcation of the frontal sutures light brown, with dark dots . . . . . . . . . . . . . . . . . . . . . . 1. **L. phaeopa** Steph. (p. 451)
2 (1). Frontoclypeus dark posteriorly; dorsal and lateral stripes fused; they form a dark broad band in the posterior half of the head together with the dark part of the frontoclypeus . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **L. reducta** Hag. (p. 453)

### 1. **Lype phaeopa** Stephens (Lype sp.)

Siltala, 1905:138—140, Figure 37.— Lestage, 1921:524, 527, Figure 174.— Hickin, 1954:93—95.— Botoşăneanu, 1952b:907—917, Figures 7—11.

Siltala (1905) described the larva of Lype sp.; he placed it in this genus because of the large differences from the larvae of Tinodes and Psychomyia and because he found many adults of Lype at the banks of streams inhabited by these larvae. Following McLachlan (1874—1880: 423—425), Siltala (1908b:9) recorded 3 species of Lype from Finland: L. phaeopa Steph., L. reducta Hag. and L. sinuata McL.; McLachlan, who described L. sinuata from Finland, examined only a few specimens; Sahlberg (1893:16) thinks that L. sinuata is a variety of L. phaeopa. Only the 3 preceding species of Lype (2 species according to Sahlberg) have been recorded from Finland or adjacent countries. Martynov (1928:6, 1934:198), who knew the Trichoptera of Karelia well, recorded only L. phaeopa. This species was recorded by Siltala (1905:135) as common in the localities studied. In view of the rarity of L. sinuata and the clearly marked differences of the larvae of Lype sp., it seems certain that the latter are the larvae of the common Lype phaeopa.

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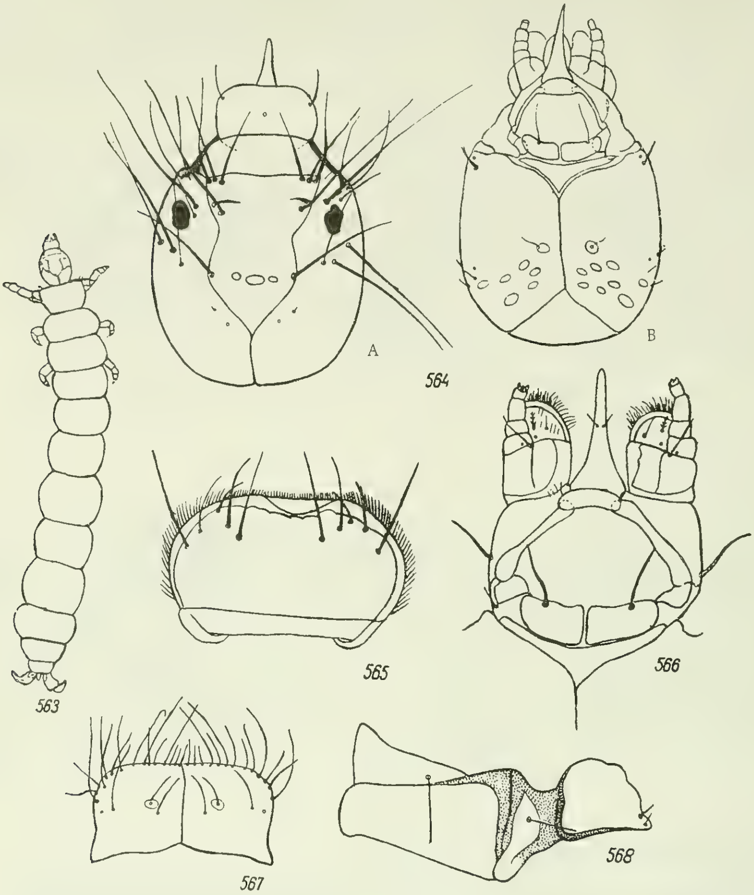


FIGURES 563–568. Lype phaeopa Steph. (after Botoşăneanu):

563 – larva, dorsal; 564 – head, dorsal (A) and ventral (B); 565 – labrum; 566 – gula and maxillolabrium; 567 – pronotum; 568 – propleuron.

**Full-grown larva.** Length 8 mm; abdomen uniformly broad in its greater part (Figure 563). Head (Figure 564) with distinct pattern; periocular area wide, yellowish white. Frontoclypeus brownish; a transverse row of 3 large light dots and short dark stripes along the frontal sutures in its posterior part. Area lateral to the anterior branches of the frontal sutures narrow and brown. Dorsal and lateral stripes and space between them dark brown, fused into a dark area. The dark areas of both sides connected in the middle of the coronal suture, forming a broad dark transverse band in the posterior half of the head together with the narrow lateral stripes of the frontoclypeus; this band is interrupted by the light part of the frontoclypeus wedged into it. Dark dots along the dorsal and lateral stripes. Area near bifurcation of frontal sutures light with dark dots; brown near the occipital foramen. Ventral side of head light anteriorly, grayish brown in the other part, with dark dots (Figure 564, B). Labrum with setae displaced to the anterior margin (Figure 565).

Median depression of mandibles present only in the distal part. Upper blade of left mandible with 2 teeth in addition to the apical tooth; lower blade with 2 distinct and 1 or 2 indistinct teeth; median depression with long chetoids that form two tufts; chetoids of basal tuft feathered. Outer setae of mandibles situated at about $^1/_4$ of its length from the base. Maxillolabium see Figure 566.

Pronotum dark brown, darker posteriorly and laterally; each half of the sclerite with indistinct dots with dark outline; anterior half of sclerite with large light dots at the base of the setae (Figure 567). Propleuron as in Tinodes (Figure 568).

403 Claw of anal legs without ventral spinules.

**Pupa.** Length 5.5 mm. Antennae reaching abdominal segments 6–7; first antennal segment broader but not longer than the following segments, with several dark setae. Labrum short and broad, with rounded anterior margin; each side of labrum with 5 weak yellowish setae. Mandibles as in Tinodes, hooklike, blade straight in the middle, indistinctly serrated. Wing sheaths pointed. Natatorial setae dense, present on first 4 segments of mid-tarsi. Claws light and weak. Presegmental plates present on segments 2–8, postsegmental plates on segment 5; number of denticles as follows: II:6–8; III:6–9; IV:7–9; V:6–7+ 12; VI:12–13; VII:6–10; VIII:8–11. Denticles on presegmental plates of segments 2–5 blunt, irregularly arranged near the posterior margin; denticles on segment 6 pointed; denticles on segments 7–8 straight and blunt; postsegmental plates of segment 5 broad.

404 Last abdominal segment of pupa divided into 2 long lobes, with 8 black stiff setae on their narrow apex; sheath of male genital appendages long; sheath of penis short.

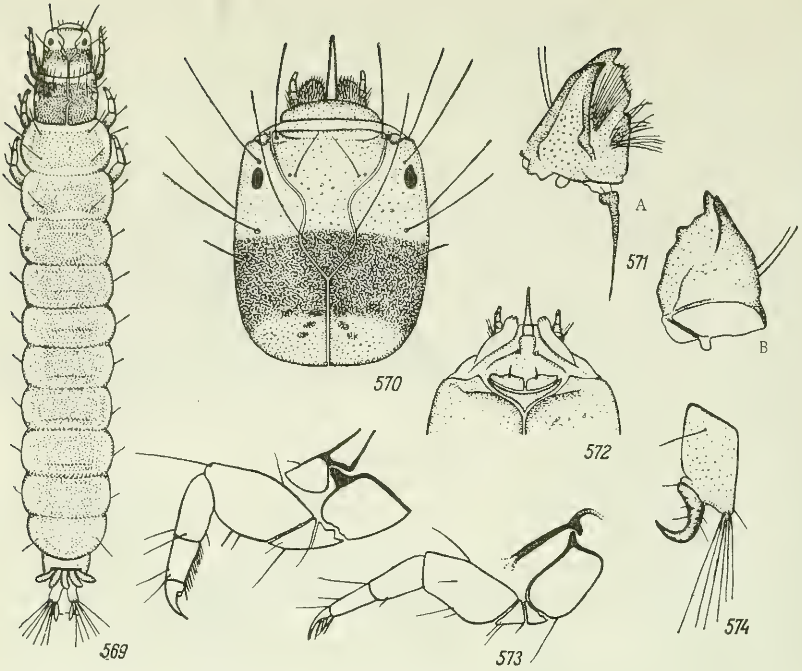
Mode of life and habitats. Running water.

Distribution. West, northwest and central parts of the European USSR. In addition, Central, northern and southern Europe, Iran.

### 2. **Lype reducta** Hagen

Hickin, 1950:71–74, Figures 1–8.

**Full-grown larva.** Length 11 mm. Closely resembling larvae of the preceding species (Figure 569). Head (Figure 570) slightly longer than broad. Area lateral to the anterior branches of the frontal sutures, periocular area and anterior part of frontoclypeus light yellow; posterior part dark brown. Dorsal and lateral stripes of head and area between them also dark brown, forming a broad dark band together with the dark of the frontoclypeus; area near occipital foramen light yellow, with large dark dots lateral to the coronal suture that are also present anteriorly in the dark part. Ventral side of head without dots (Figure 572). Posterior frontal setae long; middle frontal setae much shorter. Setae 7, 9, 12 and 14 dark and large; setae 15 short and thin but distinct.



FIGURES 569–574. Lype reducta Hag. (after Hickin):

569 – larva; 570 – head, dorsal; 571 – mandibles, dorsal: left mandible (A), right mandible (B); 572 – part of head, gula and maxillolabium, ventral; 573 – pleural sclerites and legs: anterior leg (right side) and midleg (left side); 574 – left anal leg, outer view.

405 Labrum broad and short; anterior margin membranous, almost straight, with short hairs laterally; setae smaller than in Tinodes, especially setae 5 and 6. Mandibles (Figure 571) short and massive. Upper blade of left mandible with a large tooth in addition to the apical tooth; projecting part of lower blade with 3 short blunt teeth; chetoids in the medial depression forming two brushes. Apex of right mandible with 2 large teeth on the upper and lower blades; lower blade with 2 additional, indistinct blunt teeth.

Gula as in Tinodes, broadly triangular, fused with the pregula (Figure 572); submentum as in Tinodes but slightly shorter and broader; setae near anterior margin small; palpifer and maxillary palps as in Tinodes. Ligula of labium long, thin, longer than the maxillary palps.

Pronotum dark, grayish brown, slightly broader than head, with a light stripe near the anterior margin (Figure 569). Each half of sclerite with 4 light spots, 2 median spots situated slightly anterior to the other two. Anterior-angle setae longer than the few anterior-margin setae; median surface setae and the setae near them situated on light spots.

Meso- and metathorax broader than prothorax, as broad as abdominal segments; anterior-angle and medioanal setae longer, about a third as long as the segment.

Pleural sclerites as in Tinodes.

Forelegs more massive than the others; both ventral setae of femur short; tarsus with a dense ventral comb of spinules (Figure 573). Femora of midlegs and hind legs with a relatively long distoventral seta; second seta situated nearby, small and thin; claws of midlegs and hind legs with a thin basal seta and a short spinelike process.

First 7 abdominal segments uniformly broad; segment 8 slightly narrower, convex dorsally; anterior-angle setae of this segment long and displaced posteriorly (Figure 569).

Anal legs as in Tinodes; distodorsal group of section "b" with 6 long setae and a short subapical seta; claw strongly curved, without ventral spinules (Figure 574).

Mode of life and habitats. The larvae build tunnels attached to pieces of wood; according to Hickin (1950:71—72), the larvae of Lype reducta do not settle on stones; tunnels 75 mm long; anterior end 5.5 mm wide and the posterior end 1.0 mm; tubes covered with fine sand grains and detritus. The larvae live in calm parts of rivulets; they are known from the rivulets of the Khosta and the Ptsyr-Tskha at the Black Sea coast.

Distribution. West of the European USSR, northern Transcaucasia. In addition, Europe.

### 3. Genus **Psychomyia** Latreile

**Full-grown larva.** Length 4.5—8 mm. Head yellowish, with light brown or brown pattern or without pattern. Frontoclypeus broad, with shallow lateral indentations, with a narrow blackish brown anterior margin and with 2 processes lateral to the shallow median depression of the margin; posterior part of sclerite dark, with light dots; posterior frontal setae situated near the suture.

Mandibles long; median depression present only distally; place of molar tooth with a small tubercle at the base; a deep basal groove at the outer side; light outer setae near the distal margin of this groove. Submentum pentagonal, very wide, black, blackish brown or reddish brown, with a light median suture and tuberculate surface; ligula thin, not longer or only slightly longer than maxillary palps.

Pronotum light, with indistinct or distinct brownish or brown pattern; anterior-margin setae light, long, in a row at the margin. Femora with convex dorsal margin and short ventral margin; ventral setae small. Claws of legs with 2 basal setae. Sclerite of section "b" of anal legs with a subapical and 5—7 apical setae; claw with 5 massive pointed spinules ventrally.

**Pupa.** Length about 4 mm. Antennae of female pupae reaching end of segment 6. Blade of mandibles slightly convex in the middle, finely serrate, its filiform end very thin at the apex, sinuous. Presegmental plates present on segments 2—8, postsegmental plates on segment 5. Lobes of last segment with several long stiff terminal setae.

Case 5—6 mm long, covered with sand grains, its walls rather thick.

406 Mode of life and habitats. The larvae are detritophagous and build tunnel-shaped tubes, in rivulets and brooks with solid bottom and on the open littoral of lakes.

Distribution. USSR: the European part, including the Caucasus, Middle Asia, Maritime Territory. In addition, Europe, North Africa, Western and southern Asia, North America.

Key to Species

Full-grown larva

1 (2). Processes at anterior margin of frontoclypeus relatively broad, as broad as median depression; anterior-angle processes of small gula long, narrow, very thin, blackish; submentum black or blackish brown . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **1. P. pusilla** Fabr. (p. 456)

2 (1). Processes at anterior margin of frontoclypeus narrower than median depression; anterior-angle processes of gula broader, without thin ends; submentum chestnut brown . .**2. P. shelkovnikovi** Mart. (p. 463)

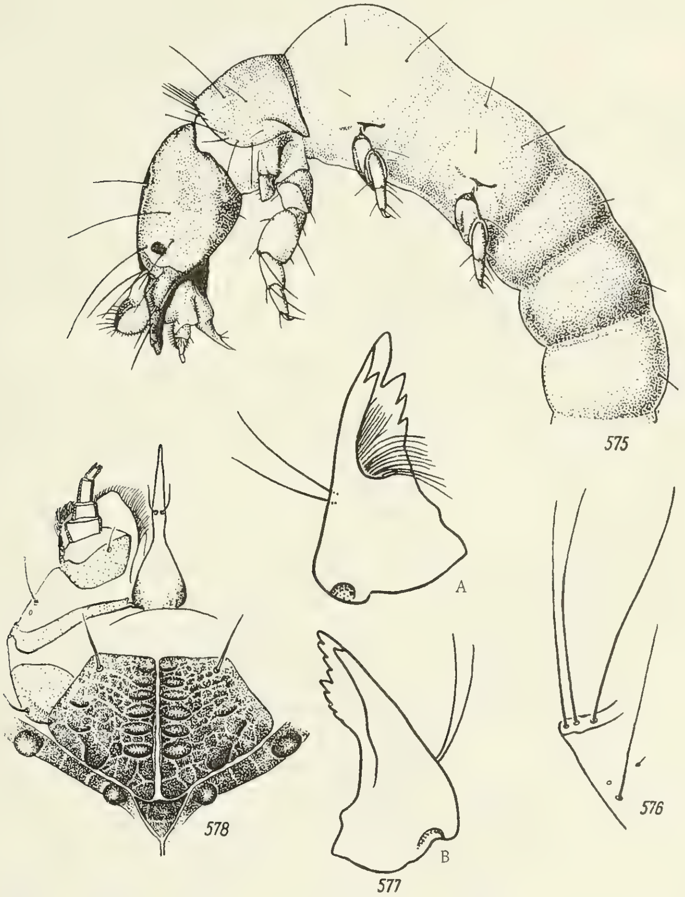
### 1. **Psychomyia pusilla** Fabricius

Siltala, 1903b:18–21; Figure 3. – Ulmer, 1903:148; 1909:232, 298, 299, Figure 357, a, c; 436. – Lestage, 1921:527–530, Figure 176. – Lepneva, 1940:203; 1956:10, 12, Figures 1, 7, 31, 34. – Brindle, 1960c:265–267, Figures 1–9.

**Full-grown larva.** Length 7.5–8.0 mm; sclerites yellow; pattern delicate, light brown or absent, except at the dark margin of the sclerites. Head (Figure 575) moderately broad, dorsal side almost as long as wide; ventral side much shorter than wide; sclerites shagreened. Eyes small. Anterior margin of frontoclypeus thickened (Figure 576), with two blackish brown processes lateral to the shallow median indentation; a trapezoidal smoke brown spot. posterior to the indentation; posterior part of sclerite brown or yellowish brown, lighter in the middle, with 3 large, indistinct, transverse elliptical, light dots. Pattern on dorsal surface absent in light specimens and the whole head, except the anterior and posterior margins, uniformly yellow. Anterior-margin setae yellowish, long, almost of the same length, situated close together, at the angles of the sclerite. Anterior frontal setae small, light, curved inward, displaced from the sutures, situated posterior to the smoke brown spot; a pit between them in the middle; middle frontal setae situated near the anterior setae, on the sides of the sclerite, brownish yellow and long; posterior frontal setae also long but not situated on light dots as in Tinodes but near them, near the suture; a small reddish pit posterior to the setae.

Head dorsally uniformly yellow or grayish yellow lateral to the epicranial suture, slightly darker on the dorsal stripes than in the other part in some specimens; a narrow dark stripe near the coronal suture; margin of occipital foramen chestnut brown, darker laterally. The following setae belong to the group of long brown setae, which are directed anteriorly and upward: seta 7 situated close to the frontal suture, setae 9 and 14; a dash-like fold runs from the base of seta 14 anteriorly around the inner side of the eye; seta 12 situated lateral to the eye, almost as long as seta 14, directed laterally; setae 11 (near 9), 10 (situated laterally, anterior to the eye) and setae 15 and 16 (posterior to 14) small and light; seta 17 situated near the bifurcation of the frontal suture spinelike, curved anteriorly, small and light (Figure 578). Anterior margin of head broadly dark brown on the ventral side, with large tubercles lateral to the gula. Gula small, triangular, with long, filiform, blackish brown anterior-angle processes; anterior margin of gula forming a thick dark brown ridge; a small part of the anterior margin shagreened. A narrow smoky brown stripe along the gular suture; smoke-gray spots and indistinct light dots posteriorly, at the sides. Seta 8 spinelike, small, curved anteriorly, transparent, situated near the anterior margin; setae 18 situated near the spots, straight and spinelike.

(407)



FIGURES 575–578. Psychomyia pusilla Fabr.:

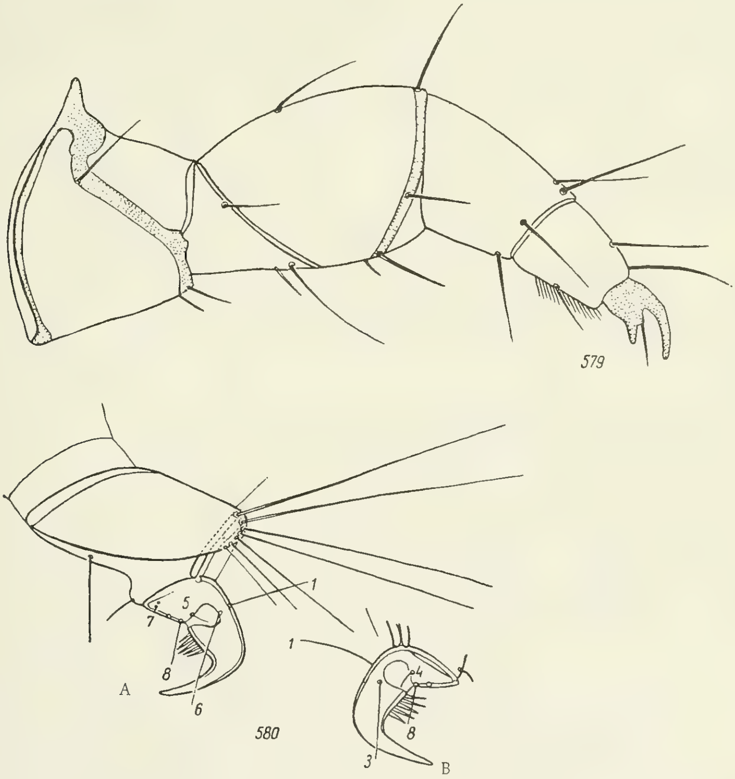
575 – head, thorax and abdominal segments 1–3, lateral; 576 – part of fronto-clypeus; 577 – mandibles, dorsal: left (A) and right (B) mandible; 578 – anterior margin of head, ventral; gula and maxillolabium.

Anteclypeus relatively long, longer than labrum, mainly light; base of the slightly dark longitudinal stripe reddish yellow. Labrum broad; membranous anterior margin straight, with short hairs in the middle, with sparser and longer hairs laterally; dorsal sclerite brownish yellow, lighter at the margin, with a shallow median indentation; posterior-angle sclerites curved, thin, darker than the sclerite. Setae thin, light yellow, similar; seta 1 shorter and thinner than the others and situated anteriorly at the margin; farther away are setae 2 and 3, which are situated lateral to the median indentation; seta 4 situated slightly away from the margin; posterior to them are setae 6 and 5, which are the longest setae of the sclerite; median pit large, situated in the posterior half of the labrum. Mandibles
407 (Figure 577) long, median depression present only distally; outer side of both mandibles with a deep, rather broad groovelike depression with a comb in the middle. Apical tooth of left mandible blunt, broad; upper blade with a tooth near it; lower blade with 3 teeth, two of them small; apical brush in the median depression consisting of short chetoids, basal brush consisting of long chetoids; molar tooth replaced by a small tubercle. Right mandible narrower than left, almost twice as long as wide at base; median depression short in apical third of mandible; lower blade with larger tooth near apical tooth; end of mandible appears, therefore, divided; it also bears 2 small serrations; second large tooth situated at a distance, projecting and with finely serrated outer margin; upper blade of mandible with one tooth; and small tubercles near the base. Outer setae of mandibles situated close together, long and light, situated about middle of mandible; anterior seta near ventral margin of apical end of outer groove, slightly longer than posterior seta.

408 Maxillolabium very wide, as usual in Psychomyiidae; almost twice as long as the gular suture when it is extended. Submentum (Figure 578) black or blackish brown, with tuberculate surface; median suture light, distinct; anterior margin straight; posterior angle of sclerite almost reaching slightly concave anterior margin of gula; primary seta situated near anterior angle of sclerite strong and light. Cardo brownish, the seta at its base thin. Stipes oblong-triangular; outer seta situated on a membrane in anterior part of sclerite, thin and yellowish, longer and thicker than seta of submentum; distal seta small and light. Palpifer reddish brown; seta near the anterior margin light and strong, almost as long as seta of stipes. Maxillary palps short, 3rd segment slightly longer than the others; the broad apically rounded lobe with numerous setae. Mentum brownish; labial lobe long; bulb-shaped at the base, with a thin ligula; ventral setae soft and light.

Pronotum with light anterior margin; anterior angles rounded; posterior angles curved ventrally (Figure 575). Sclerite light yellow; each half of the sclerite with a longitudinal, curved smoke brown figure lateral to the median suture, which is broad posteriorly, with indistinct dark and light dots; a large, light dot in the middle of the figure. Posterior margin with a thin reddish brown stripe and a brown border with indistinct light dots. Lateral margin with indistinct, brownish border in the anterior half; an oblong reddish brown spot near the pleural articulation; anteriorly and medially to the posterior angles, a bracket-shaped ridge with a dark stripe surrounding the area adjacent to the brown spot at the lateral margin. Anterior-angle seta darker and longer than anterior-margin setae; a second, shorter anterior-angle seta lateral to this seta; 4 small light setae between them. Anterior-margin setae forming two groups; the first group begins at a distance from the median suture; it consists of 5 or 6 light, equally spaced setae; the setae situated further medially longer than the lateral setae; 2 shorter widely separated setae between the median group and the anterior-angle seta. The row of anterior-margin setae, which are directed slightly upward and anteriorly, forms a fan-shaped collar above the head; this fan resembles the group of anterior-margin setae of the pronotum of Cheumatopsyche lepida. Medioanal surface seta slightly shorter than anterior-margin setae, situated near the median suture, on a light area in the anterior quarter of the sclerite; a second long seta situated farther posteriorly; a short dark seta with a light dot at the base near the anterior margin of the lateral spot; the small surface seta posterior to the median seta situated in about the middle of the sclerite.

(409)



FIGURES 579 and 580. Psychomyia pusilla Fabr.:

579 — foreleg, posterior; 580 — left anal leg, outer view (A); left claw, inner view (B).

Propleuron wide, of the same form as in Tinodes, with a broad, blackish brown pleural suture; epimeron little developed, brownish; seta near pleural suture small; basal triangle of trochantin smaller than in Tinodes, with dark, sharp ridges; its seta dark, thin and distinct; lobe-shaped process smoke brown, without hairs near the distal margin; first distal setule very thin, transparent; second setule double. Lobe-shaped process of trochantin as in Tinodes, directed to the ventral side of the head with its inner concave side in the normal position.

Prothoracic sternites paired, rodlike, slightly oblique posteriorly; the sternites touch the posterior angles of the dorsal sclerite laterally;* they are fused in the middle, forming a small process.

Mesothorax higher and broader than prothorax (Figure 575), longer than metathorax; it is the largest segment of the body; mesothorax forming a hump above the pronotum. Membranous surface of meso- and metathorax, like that of abdominal segments violet pink in fixed specimens, with white, longitudinal, narrow stripes laterally and with white dashes and dots. Medioanal seta and anterior-angle seta thin, relatively long; a small transparent intermediate seta and a lateral seta nearby; anterior-margin setae of mesonotum situated slightly away from the margin, slightly longer and situated near the margin on the metanotum.

Pleural sclerites of meso- and metanotum as in Tinodes, thin, rodlike, with a broad, blackish brown pleural suture and weakly developed episternum and epimeron.

409 Legs (Figure 579) relatively short and light, without pattern. Forelegs brownish yellow, much more massive and slightly longer and darker than midlegs and hind legs; most setae pale, thin, many of them short, rudimentary or absent. Coxa massive; articular process of basal margin as in Tinodes, conical, dark brown. Posterodorsal seta situated basally, dark brown, strong and moderately long; anterobasal seta similar, slightly shorter; second anterior seta situated nearby, thin and small. Both anterior surface setae small, light, and situated subventrally. A short yellowish posterior seta and a small, light, anterior seta distoventrally.

Posterior seta of trochanter small, thin; anterior seta longer, both setae situated distally; the basal seta of the anteroventral setae situated on the suture and the subapical spinelike setae light; long posteroventral seta situated subapically, dark and strong. Femur slightly longer than high, with short ventral margin. Distodorsal seta brown, large, strong, the longest seta of the leg; second dorsal seta situated proximal to the middle of the femur short, light and slightly curved; anterior seta short, situated subapically; posterior seta situated on a ridge at the margin; relatively large, light brown; both ventral setae small, light, situated near the apex; the posterior of these setae slightly curved, situated at the margin, longer and thinner than the subapical anterior seta. Tibia almost twice as long dorsally as ventrally; its distodorsal seta dark, strong and long; subapical seta
410 shorter, situated nearby, thin, filiform and light; anterior and posterior setae straight, dark, long; both ventral setae situated subapically; one of them yellowish, thin and long; anterior seta short and transparent, thick, slightly feathered. Tarsus narrower apically; distodorsal seta dark, strong, relatively long; subapical seta thin and transparent, slightly shorter; ventral comb of spinules pointed toward the base; both ventral setae spinelike, light, situated slightly distal to the middle of the segment; one of them

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* Line of contiguity light.

situated among the spinules, the second posterior to them. Claw blunt, curved, with convex basal process lateral to which are 2 setae; one of them in form of a short, blunt spinule with rounded apex, the second transparent and pointed.

Midlegs slightly shorter than forelegs and much thinner; light yellow, and without dots like the hind legs. Coxa relatively long, with a deep distodorsal indentation, with narrow reddish brown margin; posterodorsal seta long, brown, situated near the distal margin; both anterodorsal setae situated basally as on the forelegs, short, light yellow; anterior surface setae setuliform; distoventral setae of mid-coxa shorter than those of forelegs; posterior seta yellowish, thin; anterior seta rudimentary, setuliform. Suture of trochanter situated proximal to the middle; anterior seta spinelike, light and long; posterior seta absent; ventroanterior setae, basoventral and subapical setae thin; posterior distoventral seta light brown and long.

Distodorsal seta of femur strong, brown and long; second dorsal seta situated proximal to the middle, light and strong; anterior seta of femur short, situated subapically; posterior seta longer and nearer to apex; ventral margin of femur even shorter than on the forelegs; both ventral setae situated distally, close together, transparent and small.

Basodorsal seta of tibia displaced to the middle and much shorter than apical seta; the latter seta as long as the tibia; anterior seta brown, projecting far subapically; posterior seta shorter, light, spinelike, situated closer to the apex; unlike on the forelegs, both ventral setae are little developed; posterior seta small and transparent; anterior seta even smaller, visible only under high magnification.

Dorsal seta of tarsus thin; subapical seta slightly longer and thinner than apical seta; anteroventral seta spinelike, situated in about the middle of the segment; posterior seta thin and situated ventrodistally; only small spinules of the ventral comb present near the base of the claw. Claw with blunt basal process.

Hind legs of the same form but slightly thinner than midlegs, which are especially distinct if the femora are compared. Setae similar; anterior and distoventral setae of trochanter slightly thinner; distodorsal seta of femur shorter. Claw more strongly curved.

Ventral surface of abdomen flattened; dorsal surface convex, colored like the dorsum of meso- and metathorax, but stripes and spots less sharply marked. Only anterior-angle and medioanal setae well marked, thin and light, shorter on the first abdominal segments than on meso- and metanotum; medioanal seta of segment 8 moderately long and dark; anterior-angle seta displaced to the middle of segment.

Segment 9 with dark long medioanal seta; a thin light yellow, short [intermediate?] seta near it; ventral seta thick, dark and spinelike. The 5 anal gills diverge from the anus like a fan in fixed specimens.

Anal legs with a short section "a." Laterodorsal sclerite of section "b" brownish (Figure 580), with reddish brown, broad basal margin; articular rods reddish yellow. Two long thick dark brown setae above the rods; between them, subapically a short dark projecting seta, as in Tinodes. Four or five setae arranged in a fan on the outer side; 2 of them situated close to the dorsal setae and almost as thick and long as these; other 3 setae thinner and shorter; they become shorter toward the end of the row.

Ventral seta dark brown, moderately long, strong, situated on a membrane on the posterior quarter of the sclerite. A small light seta at the place of sclerite "c."

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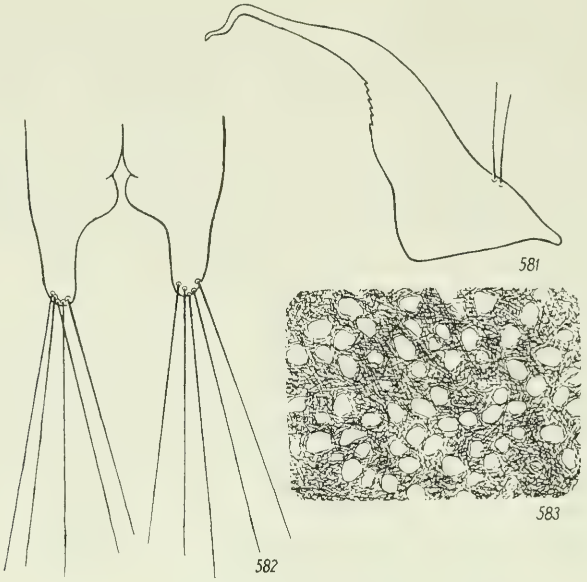

FIGURES 581–583. Psychomyia pusilla Arb. Pupa:

581 – right mandible, dorsal; 582 – anal appendages; 583 – part of membrane of pupal case with openings.

Claw (Figure 580) with broad basal part and a wide membranous transverse stripe; apical part of claw strongly curved, with 5 massive, long pointed spines ventrally; outer 2 spines of this group slightly smaller than the 3 median spines. Seta 1 situated dorsally, between basal and apical part of the claw; seta 6 situated on the outer side and 3 seta situated medially; seta 2 absent; setae 5 in the basal part on the outer side and 4 on the inner side; all yellowish, thin and small; ventral seta 8 straight and light, relatively long; seta 7 very small; a pit situated near it, near the ventral margin of the sclerite.

411 **Pupa.** Length 4.3–4.8 mm. Antennae filiform, moniliform at the end, reaching abdominal segments 6–7; first antennal segment thicker but not longer than the following segments, with several small setae. Anterior angles of labrum with 5 thin yellowish setae. Mandibles (Figure 581) long and more curved than in Tinodes; blade at base of apical filament slightly convex, finely serrated; filiform ending sinuous; outer setae near the base straight and short, of the same length; mandibles crossed at rest, right mandible above the left. First segment of maxillary palps shorter than the others; 2nd, 3rd and 4th segments of about the same length; 5th segment twice as long as preceding segments.

Wing sheaths of female pupae reaching abdominal segment 6; those of male pupae, abdominal segments 7–8. Tibiae and tarsi of midlegs of female pupae broad, first 4 segments of mid-tarsi of male and female pupae with a few light brown setae.

Holding apparatus complex; presegmental plates present on abdominal segments 2–8; postsegmental plates on segments 2–6. Spinules on presegmental plates on segments 2–5 and 8 forming a regular arc or rows; the spinules on segment 6 are more numerous and situated not only on the plate but also anterior to it; segment 7 with only 6–8 spinules. Spinules on postsegmental plates small and numerous, forming several rows; they are situated on segment 5 anterior to a narrow transverse plate; they are situated laterally near the posterior margin on segments 2–4 and 6.

Distal lobes of last segment rounded at the end (Figure 582) longer in male pupae; sheath of penis and outer appendages near base of lobes in male pupae.

Pupa lying in a cocoon of loose tissue in a case with rough, thick walls covered with fine and coarse sand grains; ventral side flat and with a broad longitudinal slit; a filtering sieve at each end of the case (Figure 583); Length of case 5–6 mm; case usually situated on stones.

412 Mode of life and habitats. The larvae live in tubular tunnels; they are detritophagous and occur in rivers and rivulets, sometimes in lakes.

Distribution. The European USSR, except the southeast. In addition, Europe.

## 2. **Psychomyia shelkovnikovi** Martynov

Fridman, 1950:48–50, Figure 2, 1–8.

**Full-grown larva.** The larva resembles that of the closely related P. pusilla; length 7.0–8.5 mm. Head markedly longer than broad. Ground color yellow; pattern distinct, grayish brown, dark brown in some places;* surface shagreened and ornamented. Processes of anterior margin of frontoclypeus more projecting than in P. pusilla, markedly smaller than the median depression (Figure 584); anterior part of sclerite posterior to the median depression, dark in the middle. Posterior part of sclerite completely dark; it appears as an irregular triangular grayish brown spot on the light background; its anterior margin convex and with a transverse row of 3 light indistinct dots. Coronal suture with a narrow brown stripe. Distal stripes indistinct, forming grayish shades, more distinct near the anterior margin. Occipital foramen with a narrow brown margin.

Head darker ventrally than dorsally; gular suture with a narrow dark stripe; wide smoke brown spots with indistinct light dots laterally and posteriorly; dark brown anterior margin narrower ventrally than in P. pusilla, with 2 large club-shaped processes. Gula small, triangular, slightly larger than in P. pusilla, without thickened dark brown anterior margin; anterior angles pointed but not as narrow and long as in P. pusilla; gula shagreened and ornamented. Setae of head as in P. pusilla; a light spot at the base of seta 18.

Dorsal sclerite of labrum darker than in P. pusilla, dark smoke brown; setae similar; setae 3 slightly longer. Mandibles similar; left mandible longer than in P. pusilla, curved distally; tooth of upper blade and 3 teeth of lower blade distinct; chetoids of penicillus similar; tooth of upper blade of right mandible small; distal tooth of lower blade projecting, sometimes with an indentation.

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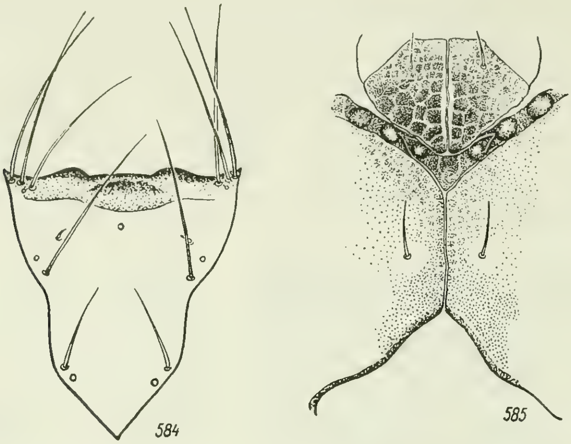
* A very light variety without pattern occurs at the boundary of the range (Psekups River).



FIGURES 584 and 585. Psychomyia shelkovnikovi Mart.:

584 – frontoclypeus; 585 – head, ventral, gula and submentum.

413 Submentum (Figure 585) dark reddish brown, slightly longer and narrower than in P. pusilla; its shagreened sculpture less marked; anterior-angle setae as in P. pusilla, light and strong.

Pronotum pale yellow; its pattern darker and more distinct than in P. pusilla, reddish brown; curved stripes in each half of sclerite and lateral dark spots with large indistinct dots; median stripe lateral to the suture with two small light spots; dark brown spot at the lateral margin small; ridge sharp and dark brown. Both anterior-angle setae dark brown, strong; 4 small light setae between them; the median anterior-margin group consists of 7 setae (sometimes 8 or 9); 2 setae between the median and angular setae, marginal seta darker than the others; surface setae as in P. pusilla. Meso- and metathorax and their setae as in P. pusilla.

Differences between forelegs and the other legs more marked than in P. pusilla; tibiae and tarsi of midlegs and hind legs relatively shorter than in P. pusilla.

Abdominal segments 1–8 and anal legs similar. Laterodorsal sclerite of anal legs reddish brown dorsally, with 3 large light spots; whitish yellow distally and near the lateral margin; 2 setae distally and dorsally; 3 dark strong setae, which become shorter ventrally laterally.

Mode of life and habitats. Rivers and rivulets with stony bottom; on the stony coast of large lakes (Lake Sevan) in plant overgrowths.

Distribution. USSR: the Caucasus and Ciscaucasia. In addition, Iran.*

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* Schmid (1959:766–767) thinks that P. shelkovnikovi Mart. is synonymous with P. pusilla Fabr.; he considers this species as very variable; the characteristic structure of submentum, gula and antero-ventral part of the head (Figure 585) are distinct characters of P. shelkovnikovi in our opinion.

## II. Superfamily NEOCHAETOIDEA Lepneva

### VII. Family ECNOMIDAE Ulmer*

**Full-grown larva.** Length 8.0–9.5 mm. Mandibles moderately long; left mandible without penicillus in the median depression. Labial lobe short, shorter than mandibles, without long ligula; labial palps relatively large and well developed. Nota of all three thoracic segments present. Trochantin long, fused with episternum, with a small spoon-shaped seta; epimeron of prothorax very wide, long in the posterior-angle area, in form of ventrally curved processes. All legs of almost the same length; claws thin, slightly curved, without ventrobasal process. Setae of thorax and legs mainly primary; secondary setae of coxae not numerous. A dense row of thin, long setae forming a spurious lateral line on abdominal segments 2–8.

Anal legs long; section "a" larger than section "b"; secondary setae of section "b" numerous; claws curved, narrow, with a ventral comb of minute spinules.

**Pupa.** Length 5.5–6.5 mm. Labrum with 5 long setae and a small seta. Apex of mandibles straight, long, pointed, without filiform end.

Dark setae present on the sides of abdominal segments 6–8. Last abdominal segment moderately long, with short rounded lobes having sparse setae of varying length that form a fan.

Mode of life and habitats. Slow running water and large clean stagnant water bodies, ponds, reservoirs and lakes. They live on the bottom, on stones, sometimes among vegetation.

Distribution. Throughout the Soviet Union; everywhere except North America.

### 1. Genus **Ecnomus** McLachlan

Larvae with the characters of the family. One genus and one species in the USSR.

### 1. **Ecnomus tenellus** Rambur

414 Klapálek, 1893:119–122, Figure 32.– Ulmer, 1903:121–122, Figure 81; 1909:231, 297–298, Figures 356, 433.– Lestage, 1921:511–514, Figure 171.– Lepneva, 1940:204; 1956:16–20, Figures 2, 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41.

**Full-grown larva.** Length 8.0–9.8 mm; head and pronotum slightly narrower than the following segments; abdominal segment 9 narrow (Figure 586). Head oblong, dorsoventrally compressed. Eyes situated on a white or yellowish area at a distance from the anterior margin; antennae situated near margin of head, near the dorsal articulation of the mandibles. Frontoclypeus (Figure 587) long, broader anteriorly, with distinct lateral indentations; anterior branches of frontal sutures at the end curved; anterior half of sclerite with a broad brown stripe with 3 light spots along the frontal sutures; posterior spot consisting of two fused spots, larger than the others; posterior part light, without dots. Anterior-margin setae of sclerite thin; intermediate seta longer than the others, strong; median seta situated nearby, slightly shorter and thinner; lateral seta light, curved, situated in about the middle between intermediate seta and anterior angle. Anterior and middle frontal setae short, thin and situated on light spots; posterior frontal seta situated posterior to the lateral indentation, dark, directed upward, the longest seta of the sclerite.

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* Considered as Ecnomidae Ulm. without the Pseudoneureclepsinae Ulm.; see Ulmer, 1951:111, 123, 135, 461, 463.

Lateral to the frontal sutures, beginning from the light periocular area and along the coronal suture are grayish brown dorsal stripes, each with 3 large, light yellow spots; the dorsal stripes extend almost the whole width of the head in dark larvae; they are adjacent to the coronal suture and extend posteriorly almost $^3/_4$ of its length; the stripes are much narrower and touch only near the bifurcation of the frontal suture in light larvae; a narrow dark stripe further posteriorly along the coronal suture. Lateral stripes absent. Head light yellow or slightly brownish, without ventral pattern; gular suture long; gula short, broad, triangular.

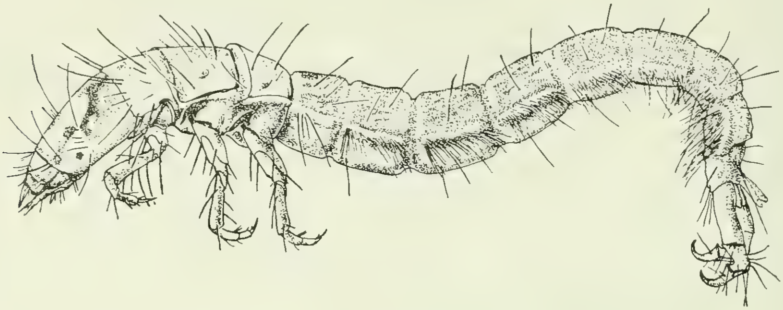


FIGURE 586. Ecnomus tenellus Ramb. Full-grown larva, lateral

Setae of large lateral sclerites brown or light brown. Seta 9 longer than the others, situated near the anterior margin of the periocular area, near the frontal suture; seta 11 situated nearby, little marked; seta 7 large, situated near the anterior margin, between the dorsoventral articulation of the mandibles; light seta 10 situated laterally, near the edge of the periocular area thin and small; the long setae 12 and 14 posteriorly and slightly laterally to the eye; thin setae 15 and 16 and the small light seta 17, which is situated near the suture, situated slightly further posterodorsally. Seta 13 absent.

Anteclypeus whitish yellow, broad, with rounded anterior angles.

Labrum (Figure 588) with rounded anterior angles and a deep median indentation, which is twice as broad as long. Dorsal sclerite light yellow, covering almost the whole upper surface; membranous anterior margin very narrow, little marked; median depression with a row of straight, short, curved hairlike spinules; indentation tuberculate; membranous margin with a row of short light hairs laterally. Median pit in posterior half of labrum

asymmetrical, slightly displaced to the right. Setae concentrated near the anterior margin; seta 1 massive, spinelike, long, transparent, curved inward; seta 2 light, thin, situated on the membranous margin; seta 3 situated laterally at the margin, longer and thicker than the others, light brown;
415 seta 6 also thick, slightly longer than seta 5; seta 4 situated near the median depression, straight, spinelike and light.

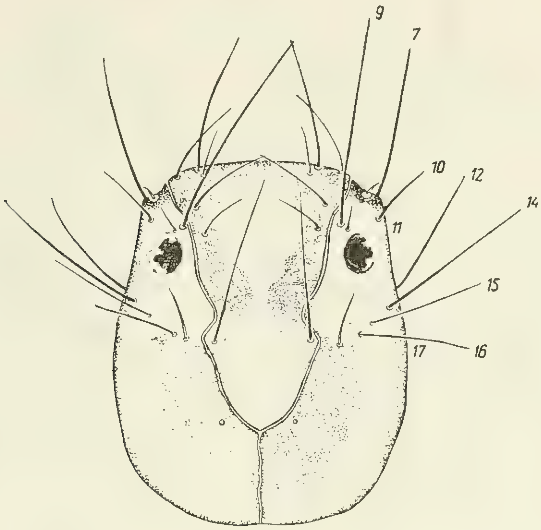


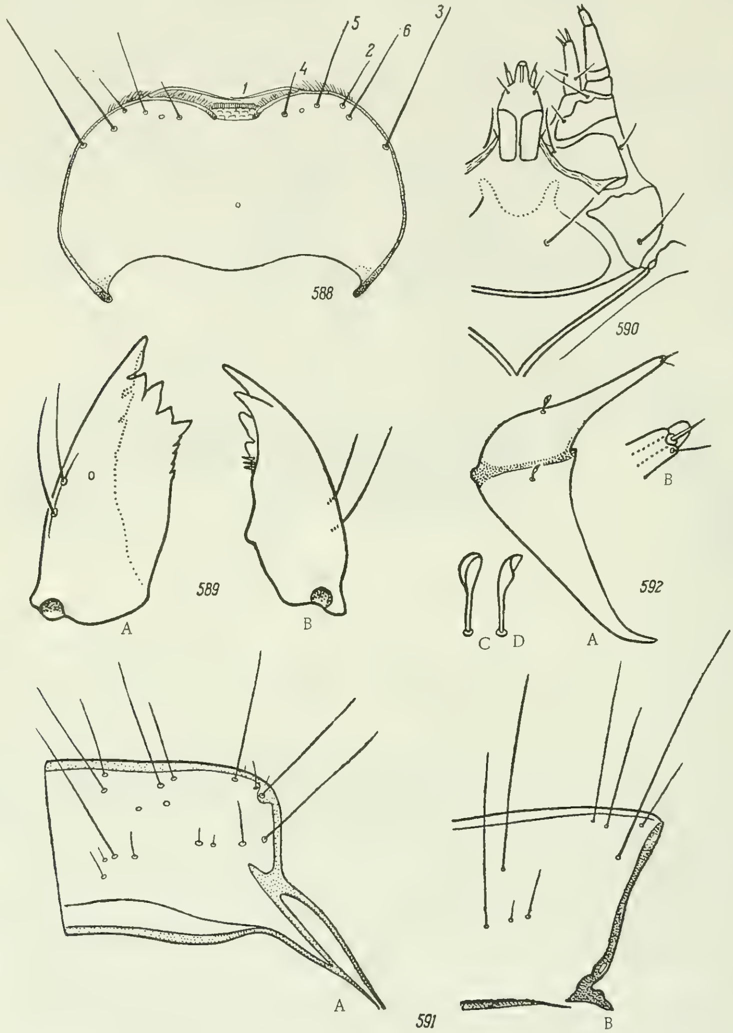
FIGURE 587. Ecnomus tenellus Ramb. Head, dorsal

Mandibles long, dark brown (Figure 589). Left mandible with a deep median depression; upper blade projecting, with 4 teeth situated slightly further basally than the large, projecting apical tooth; upper blade with a serrated part basal to these teeth; lower blade with a distinct tooth and a little marked tooth at the base of the apical tooth; right mandible with a shallow median depression; upper blade with 2 large teeth in addition to the apical tooth; lower blade with 2 small teeth and several short pointed spinules; penicillus absent.

Pregula fused with gula, fused with the head capsule.

Maxillolabium (Figure 590) with maxillae projecting anteriorly; sclerites yellow or brownish yellow, indistinguishable from the background of the membranous part. Submentum with indistinct anterior lateral processes; setae strong, situated at a distance from the margin; cardo slightly darker, brownish yellow; ventral seta thin; medioventral margin of stipes thickened, brown; a strong light seta near the apex; other part of sclerite thin, yellowish; lateral outer seta situated on a membrane, thin; maxillary palpifer broad; mediodistal angle of sclerite with a small seta; second seta situated on a membrane near the anterior margin, relatively large, situated between palp and galea, reaching end of galea; galea long, slightly curved, its setae and sensillae well marked; palps narrow, long; 1st and 2nd segments short, their sclerites not closed; 3rd segment the longest; 4th segment narrow, with short sensillae. Mentum narrower at the base, with a narrow suture; ventral sclerites small; punctiform seta straight and light; palps thin, rodlike, with long sensillae; ligula narrow, slightly longer than the labial palps, curved ventrally, very movable; labial lobe much shorter than maxillae.

(416)



FIGURES 588–592. Ecnomus tenellus Ramb.:

588 – labrum, dorsal; 589 – mandibles, dorsal: left mandible (A), right mandible (B); 590 – gula and maxillolabium; 591 – pronotum (A), mesonotum (B); 592 – propleuron (A), distal end of trochantin (B), seta of trochantin (C) and seta of epimeron (D).

Prothorax shorter and narrower than meso- and metathorax (Figure 591, A); pronotum light, without pattern; median suture thin, indistinct; dark brown posterior margin with a groove; anterior angles rounded; lateral margin near pleural articulation with a reddish brown spot (417) posterior to spot of posterior-angle process; this spot then surrounds the epimeron, extends ventrally and almost reaches the median line.

416 Anterior-angle seta straight, thin and brown; a smaller secondary seta near it. Anterior margin setae forming 3 groups: a median, an intermediate and a lateral group; first two groups situated at a distance from the anterior margin; each group consists of 2 setae, a long brown posterior seta, and a shorter and thinner seta anterior to it; the lateral group contains a long seta situated near the margin; the thickened 417 margin of the sclerite bears 3 thin, transparent, small setae between this seta and the anterior-angle setae. Surface setae also forming 3 groups; posterior part of the sclerite with 4 setae: a long brown seta, 2 short thin setae and one small seta near the long seta; the intermediate group contains 2 small indistinct setae; the lateral group consists of a long seta near the margin and a short seta at a distance from the margin.

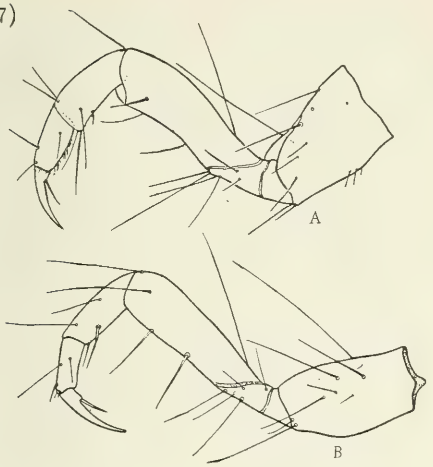


FIGURE 593. Ecnomus tenellus Ramb. Right legs, anterior: foreleg (A), midleg (b)

Mesonotum (Figure 591, B) larger than metanotum; anterior margin of both sclerites broader than posterior margin; median suture absent; mesonotum with 2 long anterior-angle setae; a short, thin, small seta on the angle; anterior-margin setae large, situated at a distance from the margin; medioanal seta long, lateral and especially intermediate seta short and thin. Setae of metanotum similar.

Propleuron (Figure 592) wide; trochantin oblong-conical, sclerotized, with soft, sucker-shaped, projecting apex; setules near the apex transparent; one of them thick at the base, second setule straight, thin; seta near base of trochantin small, spoon-shaped; process of epimeron surrounding the coxa, extending to the ventral side, where the sclerites of both sides end, not reaching the median line; seta of epimeron situated near the pleural suture, small, spoon-shaped.

Episternum of meso- and metathorax well developed, prolonged anteriorly like the trochantin, with 2 minute setules; seta of episternum (trochantin) situated on the thick margin of the sclerite, near the articulation with the coxa; epimeron, especially that of metathorax, little developed; seta of epimeron thin, small and situated on a membrane.

Legs yellow, without pattern, relatively short and thin (Figure 593); relative length of legs 80:100:104; dorsal groove of coxae absent.

Fore coxa with a dorsal indentation that reaches to about the middle of the segment. Both anterodorsal setae short and strong, massive, dark brown, spinelike; posterodorsal seta strong, brown and long; both anterior setae spinelike, one of them massive, the other much smaller and thinner, situated slightly more dorsally; a secondary seta nearby; anterior ventrodistal seta short, thin, light, posterior seta moderately long, light brown. Coxa ventrally with several thin hairlike secondary setae.

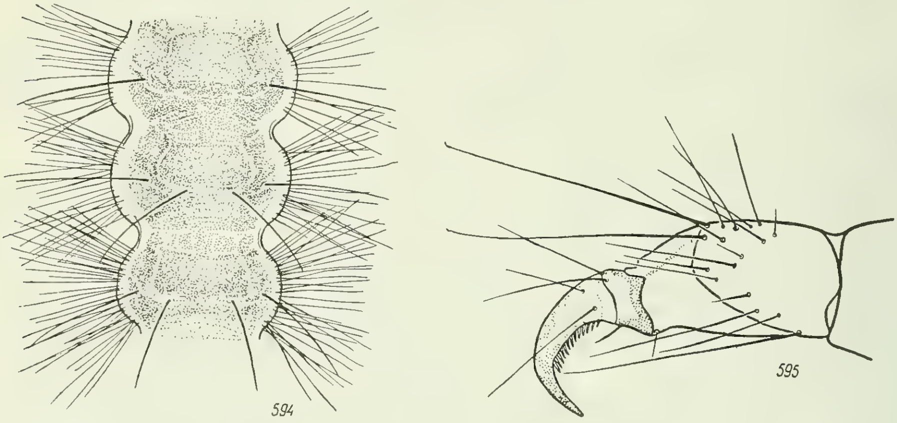
Basal segment of trochanter large, its suture distinct; anterior seta short, spinelike, light brown; posterior seta thin and light; basal seta of the 3 anteroventral setae situated at a distance from the suture, small, thin and light; subapical setae yellowish, moderately long, thin; both posteroventral setae also situated in the distal region, brown, among the longest setae of the legs.

Femur almost straight, broader apically; dorsal setae situated at a marked distance from each other; apical seta thin, moderately long; basal seta dark brown, strong and long; anterior seta in form of a massive brown spine; posterior seta light brown, thin; both ventral setae light, slightly curved, thick.

Tibia slightly longer than tarsus; subapical dorsal setae thin, light brown; posterior seta brown, long, displaced to the ventral side; anterior and anterior-distoventral seta massive, dark brown, long, spinelike; second ventral seta forming a small, transparent, slightly curved, thick spinule.

Tarsus ventrally with a comb of small spinules that leave the basal part free; spinules also near the apex; apical and subapical dorsal setae of the tarsus thin; ventral spinelike setae in the basal part, on both sides of the comb of spinules.

418 Claw long, curved; basal seta spinelike; a row of thin spinules visible only under high magnification from the base to beyond the middle of the claw.



FIGURES 594 and 595. Ecnomus tenellus Ramb.:

594 — abdominal segments 6–8, dorsal; 595 — right anal leg, outer view.

Coxa of midlegs and hind legs shorter than femur; distodorsal indentation reaching the basal third of the segment. Anterodorsal setae of midlegs dark, longer and thinner than on the forelegs; they are brown strong setae of the ordinary type on the hind legs; posterodorsal seta of hind legs shorter than on the forelegs and midlegs; anterior setae of both legs farther from the apex than on the forelegs; one of them long, spinelike on the midlegs, brown and strong on the hind legs; second seta shorter and thinner than on the forelegs; near it a small secondary seta; anterior ventrodistal seta of coxae thin and long; posterior seta shorter than the anterior seta.

Anterior seta of trochanter of midlegs and hind legs long, strong, brown, not spinelike as on the forelegs; posterior seta small and thin; 2 anteroventral setae thin, hairlike, the third light brown, longer and thicker; both posterior setae strong, dark brown and long.

Femur longer than on the forelegs; dorsal setae longer; anterior seta normal (not spinelike as on the forelegs), brown, moderately long, situated subventrally; posterior seta dark brown; it is strong and thick on the midlegs, short and spinelike on the hind legs; both ventral setae light, almost transparent, spinelike, slightly longer than on the forelegs.

Tibiae of midlegs and hind legs similar; dorsal setae thin; midlegs with only one seta; both setae displaced almost to the middle of the segment on the hind legs; anterior seta brown, strong, displaced from the distal margin farther than on the forelegs; posterior seta of midlegs thin; that of hind legs light, short, thick and spinelike; both ventral setae situated in the distal part, dark brown; they are spinelike on the midlegs; both are situated subapically and one is thinner than the other on the hind legs.

Tarsi of midlegs and hind legs ventrally with small and hardly visible spinules; spinules at apex distinct. Distodorsal seta forming a light, short, curved spine and 2 hardly marked spinules near it at the margin; second dorsal seta thin, directed upward; anterior and posteroventral setae situated in the basal part of the tarsus, on the sides of the segment; they are spinelike, thinner than on the forelegs.

Claw long, slightly curved, with a spinelike basal seta; a short row of small spinules from this seta to the margin of the claw.

First abdominal segment slightly narrower and shorter than the following segments; segments 2–4 and 5–6 of about the same width; abdomen tapering posteriorly on abdominal segments 7–8 (Figure 594); segment 9 much smaller than the others, without dorsal sclerite; anal slit with 4 short anal gills. Chaetotaxy of abdomen complex because of the presence of thin, long secondary setae on the anterior part of abdominal segment 1, which are numerous on the pleura of segments 2–8, bordering the
419 body like a lateral line. Anterior-angle and medioanal setae of the primary dorsal setae long; ventral setae also long; all setae thin and light. Anterior-angle setae of segment 9 together with the surface setae situated, as usual, in the posterior part of the segment, near the margin. Five anal gills.

Anal legs long, narrow, very movable; section "a" much longer than "b," without setae. Sclerite "b" indistinct, light yellow, with grayish brown dots; prongs of "fork" geniculate bend dark brown and long; a long brown seta dorsally above them; a similar seta situated distally on the sides of the sclerite; ventrobasal seta strong, shorter than the distodorsal setae; a row of thin, shorter setae between this seta and the distodorsal seta; thin, moderately long setae and very small hairlike setae in the dorsodistal part; a small basal sclerite ventrally. The small rounded sclerite "c" with a short, yellow, spinelike seta.

Claw (Figure 595) narrow, long, curved at almost a right angle; basal part of claw shorter than the apical part, which has a comb of spinules ventrally. Setae 1 and 2 thin and long, like seta 6; seta 3 shorter; seta 4 thin and light; seta 5 forming a microscopic light spinule; seta 8 short and strong, spinelike and light; seta 7 absent.

**Pupa.** Length 5.8–6.4 mm, spindle-shaped. Antennae of female pupae reaching the end of abdominal segment 4, of male pupae segment 7 or the beginning of segment 8. Clypeus with 3 thin setae laterally; median seta small. Labrum short, broad; 2 strong, relatively long setae in the middle of each half of the labrum; 3 strong lateral setae and a small thin median seta laterally, near the margin. Distal part of mandible narrow, straight, pointed; blade finely serrated; short, basal outer setae straight, of the same length.

Wing sheaths reaching end of segment 5 or beginning of segment 6. Mid-tarsi with sparse natatorial setae. Presegmental plates present on segments 3–8, postsegmental plates on segment 5; sclerites at base of spinules thin, indistinct; rows of spinules on presegmental plates shorter than on postsegmental plates, but the spinules are longer; number of spinules as follows: III:8–10; IV:9–12; V:6–7; VI:8–9; VII:5–6; VIII:5–6; rows on postsegmental plates containing 12–20 anteriorly-directed spinules.

Sides of segments 6–8 and 9 with dense dark reddish brown hairs. Segments 8 and 9 narrow; segment 8 short; lateral lobes covered with numerous black setae at the end of segment 9 in both sexes; these setae are longer in females than in males.

Pupa lying in a grayish cocoon of loose tissue; cocoon enclosed in a case of irregular form, made of coarse and fine sand grains; case attached to a stone or other objects. The remarkable characteristic of the case is the presence of round filtering sieves near the anterior and posterior end; these sieves are of the same type as in the tubes of Integripalpia. Length of case 7–9 mm.

Mode of life and habitats. Stagnant and slowly running water; mainly in lakes, often in reservoirs and water bodies in floodlands; they occur in plant thickets in rivulets and rivers in the plains; they are known from lakes in Karelia, lakes in the central parts of the European USSR, lakes in the Urals and the Caucasus, Lakes Zaisan, Issyk Kul and Khanka, lakes of the southern Sakhalin, and is common in reservoirs.

Distribution. Whole European USSR, including the Caucasus, Crimea and Urals, Middle Asia, Far East, southern Sakhalin. In addition, Europe, North Africa, Asia Minor, Iran, India, Tibet, China, Taiwan, Japan.

## VIII. Family POLYCENTROPODIDAE Ulmer

**Full-grown larva.** Length to 22 mm. Body slender, slightly dorsoventrally compressed. Frontoclypeus broad, with deep lateral indentations; gula short, broadly triangular. Setae of head thin; only primary setae present. Pronotum sclerotized; meso- and metanotum membranous. Legs with numerous secondary setae. Tracheal gills absent; 5 anal gills. Anal legs long. Claw long.

**Pupa.** Spindle-shaped. Antennae thick, with short segments, not reaching end of body. Maxillary palps 5-segmented. Number of spurs on legs 3, 4, 4. Last body segment with 2 short lobes which have numerous dark strong setae.

Pupae lying in cocoons of loose tissue enclosed in a cavelike case; case covered with sand grains or small stones.

420 Only the larvae of Polycentropodinae of the two subfamilies recorded from the USSR are known.

Mode of life and habitats. Mainly in running water of various types; some species occur in lakes and in clean, small stagnant water bodies.

Distribution. Throughout the USSR; cosmopolitan.

## Subfamily POLYCENTROPODINAE Ulmer

**Full-grown larva.** Length 10–22 mm. Head dorsoventrally flattened; eyes situated near the anterior margin, sometimes very small; antennae situated at the margin of the head, with one long and 2 short setae. Frontoclypeus with broad anterior margin; sides of margin with distinct clypangulus. Gular suture long. Labrum rounded laterally, with a shallow median indentation.

Mandibles long, flattened anteriorly, with pointed, well-marked teeth; median brush of left mandible small, consisting of long stiff hairs. Submentum complete, without median suture. Maxillary palps thin; third segment much longer than 1st and 2nd segments together; galea narrow, long, slightly conical. Labial lobe also narrow, prolonged anteriorly; labial palps thin, well developed.

Pronotum convex, compressed posteriorly, with a deep groove; posterior angles of sclerite long, extending to the ventral side.

Propleuron with well-developed episternum and epimeron; process of trochantin conical; epimeron in form of a narrow plate, curved ventrally, where it extends parallel to the posterior-angle process of the pronotum. Legs with long coxae and femora, with few secondary setae; forelegs shorter than midlegs and hind legs; claws narrow, slightly curved.

Meso- and metathorax and abdominal segments with a delicate pattern of white stripes and spots; the thin anterior-angle setae, medioanal setae and one of the ventral setae of these segments relatively long; sides of abdominal segments (as in larvae of Ecnomus) with a row of thin long secondary setae. Section "a" of the anal legs with a transverse constriction; section "b" and sometimes also section "a" with numerous secondary setae; claws narrow and long, slightly curved at the end.

**Pupa.** Length 10–13 mm. Head broad. Labrum short, with rounded anterior margin and a small uniformly broad median process; 3 of the dorsal setae long. Mandibles thin, sickle-shaped, without teeth, with massive base; outer setae near base short, of the same length. Wing sheaths short; natatorial setae of mid-tarsi light and delicate; mid-tibiae and tarsi of females slightly broadened; claws of legs distinct. Plates of holding apparatus small, presegmental plates present on segments 3–8, postsegmental plates on segment 5. Segments 2–7 with thin, long, filiform gills;

gills on segment 2 with one filament; gills on the other segments with 2 filaments. Anal appendages of segment 9 short, broad, with a fan of stiff setae.

Pupal case with open ventral surface; ventral surface covered with grayish tissue; walls made of sand grains or small stones. Pupa lying in a cocoon made of loose tissue with small openings at each end.

Distribution. Throughout the USSR; cosmopolitan.

Key to Genera of Polycentropodinae

Full-grown larva

1 (9). Pattern of head varying; section "a" of anal legs longer than section "b," with secondary setae.
3 (4). Head large, broad, slightly broader than prothorax, with a characteristic light small transverse elliptical figure on the frontoclypeus; eyes small or very small. Claws of anal legs long, slightly curved; 2 rows of minute spinules ventrally; a band of spinules near the distal margin on the dorsal side and at the sides . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Plectrocnemia** Steph. (p. 475)
4 (3). Head capsule, markedly longer than broad; smaller eyes. Claws of anal legs bent at an almost right angle; 1–3 dorsal spinules larger than the others.
421 5 (8). End of claw of anal legs with a small denticle ventrally, or denticle absent.
6 (7). Tibiae and tarsi of forelegs short. Claw of anal legs with a larger dorsal spinule; pattern of dorsal surface of head consisting of stripes and dots, distinct . . . . . . . . 2. **Polycentropus** Curt. (p. 488)
7 (6). Tibiae and tarsi of forelegs normal. Claw of anal legs with 2 or 3 large dorsal spinules; pattern of dorsal surface of head not always distinct . . . . . . . . . . . . . . 3. **Holocentropus** McL. (p. 498)
8 (5). End of claw of anal legs with 4 distinct denticles ventrally . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4. **Cyrnus** Steph. (p. 510)
9 (1). Posterior part of frontoclypeus with a transverse, slightly undulate row of distinct small dark dots. Section "a" of anal legs shorter than section "b," without secondary setae . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5. **Neureclipsis** McL. (p. 519)

Pupa

1 (8). Lobes of anal appendages rounded at the end, with setae arranged in a fan; subapical spurs of hind tibia of different length.
2 (7). Labrum with 2 long and 4 short setae.
3 (4). Fore tarsi without setae; lateral seta of clypeus short; other two setae long . . . . . . . . . . . . . . . . 1. **Plectrocnemia** Steph. (p. 475)
4 (3). Fore tarsi with natatorial setae on segments 2–4; lateral seta of clypeus short or long, like the other two.
5 (6). Setae of first segment of fore tarsi present only apically, sometimes absent; lateral seta of clypeus short . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. Polycentropus Curt. (p. 488)

6 (5). Setae present along the whole first segment of fore tarsi, lateral seta of clypeus not always short, sometimes long . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **3. Holocentropus** McL. (p. 498)
7 (2). All setae of labrum short . . . . . . . . . . . **4. Cyrnus** Steph. (p. 510)
8 (1). Lobes of anal appendages rounded laterally, pointed; subapical spurs of hind tibiae of the same length . . . . . **5. Neureclipsis** McL. (p. 519)

### 1. Genus Plectrocnemia Stephens

**Full-grown larva.** Length 20—22 mm. Head large, slightly broader than pronotum; eyes small. A transverse elliptical or rhomboidal light spot, which is sometimes divided on the frontoclypeus between the curvature of the frontal sutures; posterior to this spot a posteriorly-curved row of 6—8 dots; 2 oblique rows of 4 dots anterior to this spot; one of them, a dark small posterior dot, situated at the curvature of the frontal sutures. Dorsal stripes closely contiguous to the epicranial suture, with coarse dots; their outer margin not always distinct; lateral stripes broad, pale, with numerous minute dots and a few coarse dots.

Anterior part of pronotum light; a dark slightly curved transverse stripe with coarse dots in the middle of each half of the sclerite; posterior to the stripe, some distance from it dots forming an irregular arc, which is interrupted at some points; arc convex posteriorly. Two or three dots situated laterally, near the posterior half of the median suture.

Fore tibia, fore tarsus and fore claw of almost the same length or of slightly different length; tarsus ventrally with a comb of short, golden yellow spinules. Claw thin, slightly curved; basal seta forming a straight, thin, light spine.

Section "a" of anal legs longer than section "b," broader at the base than at the end; posterior third of section "a" with a shallow constriction; numerous secondary setae ventrally and on the sides. Dorsolateral sclerite of section "b" light yellow, with indistinct coarse dots or with groups of minute dots. Claw long, thin, slightly curved, with a double comb of fine spinules ventrally and a subapical band of slightly longer spinules, which do not extend to the ventral side. Five anal gills.

**Pupa.** Length of male pupae 10.0—11.5 mm, of female pupae 12 mm. Antennae of male pupae reaching abdominal segment 9, antennae of female pupae segment 6. The lateral seta of the 3 setae of the clypeus, very small, almost setuliform; the other two are long; posterior part of labrum with two similar long setae anterior to them; other 4 setae of labrum small.

Wing sheaths reaching abdominal segment 4. Mid-tarsi with thin delicate natatorial setae on segments 1 and 2; fore tarsi without setae. Hind tibiae
422 with subapical spurs of different length. Gills present on segments 2—7; gills on segment 2 with one filament; gills of the other segments with two filaments; dorsal branch of gills on 1 or 2 posterior segments shorter than ventral branch. Presegmental plates present on segments 3—7, postsegmental plates on segment 5. Anal appendages rounded, widely separated, with numerous stiff dark setae.

Pupae lying in a long case with thick walls covered with coarse sand grains or detritus.

Mode of life and habitats. Small cool rivulets and brooks, in springs and in caves; on stones on solid bottom, on large pieces of trees.

Distribution. European USSR: the Caucasus, the Crimea, Southern Maritime Territory. In addition, Europe, North China, Iran, Pakistan, India, Australia.

Key to Species

Full-grown larva

1 (2). Punctate figure in the middle of the frontoclypeus almost round; end of rows of dots close together anteriorly . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **P. conspersa** Curt. (p. 476)

2 (1). Punctate figure in middle of frontoclypeus oblong; end of rows of dots widely separated anteriorly . . . . . 2. **P. latissima** Mart. (p. 484)

### 1. Plectrocnemia conspersa Curtis

Pictet,* 1834:219, Plate XIX, Figure 1. — Klapálek, 1893:116, Figure 31. — Struck, 1903:119, Plate IV, Figure 1. — Ulmer, 1903:119—120, Figures 45, 106, 123; 1903c:348—349. — Siltala, 1903c:12, Figure 5; 1907:406, Figure 6, a, b, c, e, f. — Ulmer, 1909:230, 297, Figure 355a. — Lestage, 1921:488, Figure 157. — Nielsen, 1942:395—413, Figures 50—63. — Hickin, 1947:114—117, Figures 1—11. — Satija, 1959c:158—168.

**Full-grown larva.** Length 20—22 mm, width of head 2.4 mm; body slender, ratio of width of body to length = 0.16; ratio of length of head, thorax and abdomen = 10:19:44. Head brownish yellow; pattern brown, with large, distinct dark dots (Figure 596, A). Eyes small, situated on a yellowish white background; antennae situated near the margin, near the clypangulus, with 3 setae and a small sensilla. Frontoclypeus, as characteristic for Polycentropodinae, broad anteriorly, with deep lateral indentations and a dark dot at the curvature; a small transverse light elliptical spot in the middle of the sclerite, between the frontal sutures; 3 large oblique dots anterior to the spot on both sides; a curved row of dark dots in the posterior part of the sclerite; Median anterior-margin setae very small, curved inward; intermediate seta situated near it, lateral seta displaced to the anterior angle, and posterior frontal seta all relatively large; anterior and middle frontal setae small. Dorsal and lateral stripes indistinct, with a few large dots. Head, including gula, broadly dark in the middle of the ventral side (Figure 596, C), light laterally; groups of coarse dark dots near the occipital foramen. Seta 9 longer and thicker than the other setae; seta 7 also large; seta 11 situated near seta 9, resembling the anterior frontal seta; setae 10 and 13 situated lateral to the eye, small, setuliform. Setae 12 and 14 situated posterior to the eye, large, long, slightly shorter than seta 9; setae 15 and 16 situated behind each other on a dark transverse stripe between the dorsal and lateral stripes, thin and small; anteriorly displaced seta 17 similar, situated near the suture, slightly anterior to the posterior frontal seta.

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* As in Hydropsyche senex Pict.

Labrum (Figure 597) broad, short, rounded laterally, with a shallow, median indentation; dorsal sclerite of labrum yellow, covering labrum almost completely, leaving only a narrow membranous margin near the median indentation free; this margin covered with dense, short hairs; longer and sparser hairs on the sides of the labrum; a narrow black stripe posteriorly in the middle. Posterior angles and posterior-angle sclerites black. The thin curved converging setae 1 anteriorly, on a membrane; other setae also thin, light; seta 3 longer; seta 6 stronger than the others.

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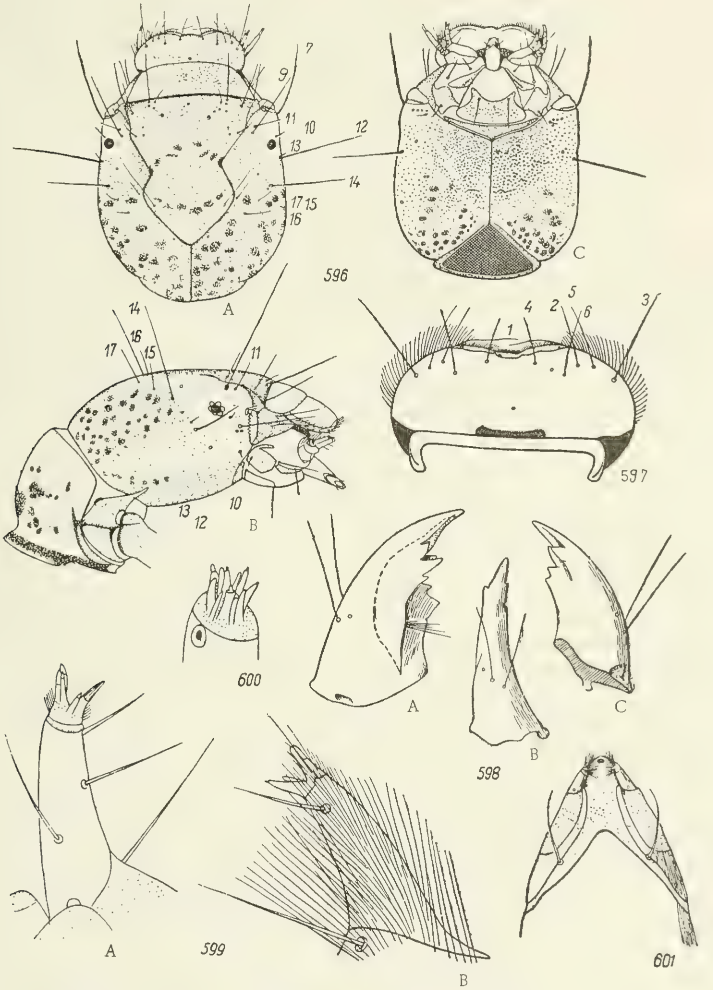


FIGURES 596–601. Plectrocnemia conspersa Curt. (after Nielsen):

596 – head, dorsal (A), lateral (B) and ventral (C); 597 – labrum; 598 – mandibles: left mandible, dorsal (A), right mandible outer view (B) and dorsal (C); 599 – galea, dorsal (A), ventral (B); 600 – distal end of 4th segment of right maxillary palp, ventral; 601 – mentum and labial lobe, ventral.

Mandibles (Figure 598) slightly curved, flattened; left mandible larger than the right, with a deep median depression and a long, pointed, terminal
423 tooth; upper blade with 3 teeth; middle tooth of this group larger than the others; lower blade with 2 teeth; basal tooth larger; median depression with a brush of long hairs. Lower blade of right mandible with 2 teeth; upper blade with one tooth; a small denticle at the base of this tooth. Outer setae almost straight, of the same length, situated near the basal margin;

Maxillolabium (Figure 596, C) broad in the middle of the basal part; narrower in the apical part. Submentum with projecting anterior angles; setae near them strong and spinelike. Cardo irregularly quadrangular,
424 with a small, posterobasal process; seta of sclerite small and thin. Stipes oblong-triangular, with dark median margin; both setae of stipes situated near the sclerite, on a membrane. Palpifer broad at the base, narrower apically; basal seta very small, situated on a sclerite; apical seta relatively long, situated on a membrane. Galea long and narrow, slightly conical (Figure 599), with a closed continuous sclerite; 2 setae near the base of the sclerite, one of them strong, relatively long; galea with 3 shorter setae and 2 thin apical setae; membranous apex with 5 sensillae. Palp long, thin; sclerites of segments annular; first two segments small and short; 4th segment narrower, slightly longer; 3rd segment longer than all the others together; apex of 4th segment with relatively large sensillae in a dense group (Figure 600); some of them two-segmented. Mentum light yellow, relatively large, with a median process at the anterior margin (Figure 601); ventral sclerites of labial palpifer with a broad basal part and a long apical part; a thin seta more medially. Labial palps well marked, with relatively long sensillae and a brush of hairs.

Pronotum (Figure 596, B) mainly yellow, brownish near the posterior angles, near the ventral process; posterior margin of sclerite separated by a transverse groove and broadly black dorsoventrally narrower (Figure 602). Dots large, dark, 2 or 3 dots along the median suture and on the sides of the sclerite (on the dark transverse stripe and posterior to it in a curved row); isolated dots near the anterior angles. Number of setae of pronotum given in Table 10. Three longer and thick setae stand out among the numerous setae of different length at the anterior margin; they are situated slightly away from the anterior margin; seta closest to anterior angle longer and darker than the others; anterior angle with a long, thick seta; a shorter seta near the black lateral margin, near the anterior-angle seta small setae at the margin between it and the thick lateral seta. Each half of sclerite with 2 long primary setae, one near the median suture and one lateral seta among the dots, in about the middle of the half of the segment; a pit and 2 short setae between the above setae, near the former seta, other setae thin situated near the primary setae; isolated setae situated in the anterior half of the sclerite. Number of setae of prothorax, legs and abdomen are given in Table 10 (after Nielsen).

Mesothorax (Figure 603) larger than metathorax; both segments with a complex light pattern; two longitudinal white punctate stripes stand out on the dorsum, and also a transverse stripe, which is interrupted in the middle posterior to the segment. Anterior-margin setae well marked, shorter on the metathorax than on the mesothorax; anterior-angle and medioanal setae long, about as long as the segment; intermediate and lateral setae situated near the medioanal setae, small; near a small secondary seta near the anterior-angle seta.

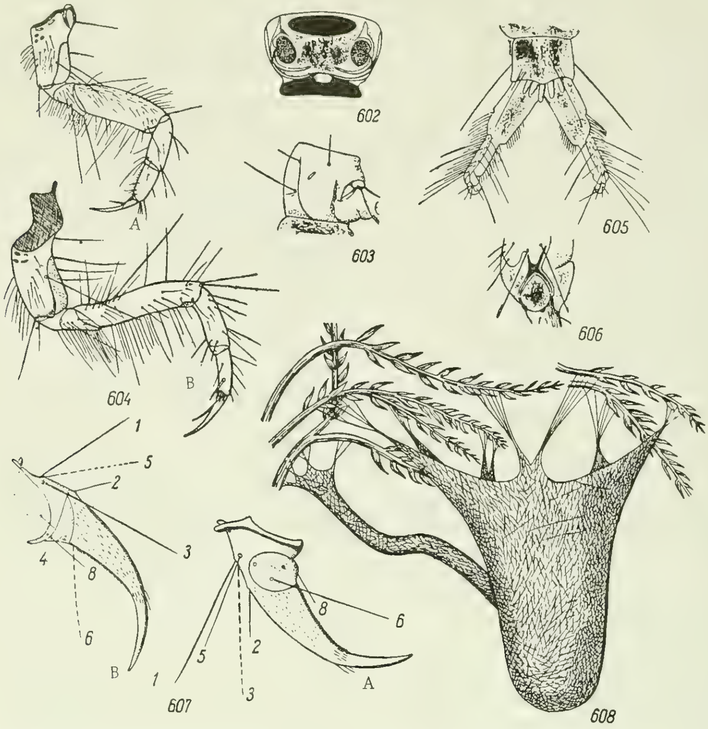
(425) TABLE 10

| Setae | Stage | |
|---|---|---|
| | 1st | 5th |
| Pronotum | | |
| Anterior-margin setae and lateral setae, including anterior-angle seta | 1 | 36–48 |
| Surface setae | 4 | 10–12 |
| Foreleg | | |
| Coxa: | | |
| Anterior dorsodistal setae | 1 | 3–4 |
| Anterior, posterior and ventral setae | 2 | 22–27 |
| Trochanter: | | |
| 1st segment | 1(?) | 2 |
| 2nd segment | 6 | 36–43 |
| Femur: | | |
| ventral setae | 2 | 17–19 |
| anterior | 1 | 26–36 |
| posterior | 1 | 33–40 |
| Tibia | 6 | 18–21 |
| Tarsus: | | |
| thick setae of anterior side | 0 | 3–5 |
| other secondary setae | 0 | 11–16 |
| Midleg | | |
| Coxa: | | |
| anterodorsal setae | 2 | 10–13 |
| posterodorsal setae | 1 | 1–3 |
| anteroventral setae | 2 | 25–31 |
| posterior surface setae | 0 | 8–11 |
| Trochanter: | | |
| 1st segment | 1(?) | 2 |
| 2nd segment | 6 | 54–63 |
| Femur: | | |
| ventral setae | 2 | 21–24 |
| anterior | 1 | 40–46 |
| posterior | 1 | 25–31 |
| Tibia | 6 | 16–20 |
| Tarsus, secondary setae | 0 | 7–9 |
| Tarsus | | |
| Coxa: | | |
| anterodorsal setae | 2 | 6–7 |
| posterodorsal setae | 1 | 1–2 |
| anteroventral setae | 2 | 18–22 |
| posterior surface setae | 0 | 6–11 |
| Trochanter: | | |
| 1st segment | 1(?) | 2 |
| 2nd segment | 6 | 45–52 |
| Femur: | | |
| ventral setae | 2 | 19–24 |
| anterior | 1 | 20–25 |
| posterior | 1 | 20–25 |
| Tibia | 6 | 13–16 |
| Tarsus, secondary setae | 0 | 6–8 |
| Abdomen | | |
| Lateral setae: | | |
| 2nd segment | 2 | about 32 |
| 3rd " | 2 | " 45 |
| 4th " | 2 | " 45 |
| 5th " | 2 | " 52 |
| 6th " | 2 | " 44 |
| 7th " | 2 | " 28 |
| 8th " | 2 | " 15 |
| Ventral setae of segment 9, median setae | 2 | 19–23 |
| Anal legs: | | |
| "a" | – | about 100 |
| "b" | | |
| on the sclerite | – | 50–60 |
| ventrally in the middle | – | 9–13 |

Propleuron (Figure 596, B) large, slightly darker than pronotum, brownish, with black pleural suture; trochantin with a hornlike process with membranous apex; ventral side of apex with two setules; seta at base of trochantin small and thin; ventral process of epimeron narrow, pointed;

seta near pleural suture small. Pleural sclerites of meso- and metathorax small; episternum fused with trochantin, larger than epimeron; end of trochantin with 2 light setules; membrane near the sclerite with a small seta; seta of epimeron situated on a membrane posterior to the sclerite.

(426)



FIGURES 602–608. Plectrocnemia conspersa Curt. (after Nielsen):

602 – prothorax, ventral; 603 – mesothorax, right side; 604 – right legs, posterior: foreleg (A), hind leg (B); 605 – abdominal segment 9 and anal legs, dorsal; 606 – left leg, distal end, articulation of claw and sclerite "b"; 607 – claw of right anal leg, outer view (A) and inner view (B); 608 – dwelling chamber and capturing net of larva.

Legs short, narrow, with long segments; forelegs shorter but slightly broader than midlegs and hind legs; ratio of length of legs = 81:100:113. Legs mainly yellow, brownish in some places; coxae with black basal margin. Secondary setae numerous (Table 10).

Coxa of forelegs (Figure 604, A) with a basodorsal articular process; apicodorsal indentation deep; several large light and dark dots posteriorly and ventrally near the basal margin. Dorsal setae straight, long; posterior setae situated in the middle of the indentation longer and thinner than the anterior setae; basoanterior seta situated near the base; other 3 setae situated anteriorly; the primary seta and 2 secondary setae form a row of shorter, strong, dark, thick setae at the margin of the indentation. Both distoventral setae of coxa straight, strong, moderately long; anterior seta shorter than posterior seta. Surface of coxa with numerous short secondary setae; strong, thick, partly spinelike setae, which are sparser, light and thin anteriorly, posteriorly and ventrally.

Both segments of trochanter completely sclerotized. Secondary setae of basal segment isolated; setae of apical segment numerous, covering the primary setae; apical ventral posterior primary seta long, thin, subapical seta thicker.

Dorsal surface of femur without secondary setae; setae situated subdorsally forming an anterior and posterior row bordering the smooth dorsal 425 stripe; basodorsal primary seta long; apicodorsal seta slightly shorter; ventral setae numerous, forming a longitudinal row; one of them [primary?] longer than the others; secondary setae of different length on the anterior and posterior surface, subdorsally and in the middle.

Two long dorsal primary setae near the apex of the tibia; anterior surface spinelike, strong; posterior seta small, dark, yellow, thin; both setae situated apically; distoventral primary setae spinelike; posterior seta long, thicker than the anterior seta; secondary setae not numerous (12—15); 2 longer setae situated dorsally at the base.

Tarsus with a ventral comb of thin, yellow, straight spinules, which is displaced to the anterior side at the base; primary setae, the posterior of 426 which is spinelike, strong and dark lateral to the comb in the apical part; anterior seta lighter and thinner; one of the two dorsal primary setae situated distally and thin, second seta smaller, situated near the middle; secondary setae of tarsus few in number (Table 10). Claw thin, brown, slightly curved; seta straight, with small light spinules at the base.

Midlegs and hind legs (Figure 604, B) lighter than forelegs, yellowish. Coxae longer, their dorsodistal indentation deeper; posterodorsal seta thin, larger than on the forelegs; anterior secondary setae of midlegs more numerous than on the forelegs (Table 10), forming a row at the margin of the indentation and ventral to it; anterior ventrodistal seta long, thin; posterior seta shorter and thicker; secondary setae, especially those of the midlegs numerous and strong. Trochanter with numerous long, thin secondary setae; ventrodistal setae situated among them not projecting as much as on the forelegs. Femur long, rodlike; hind femur longer than mid-femur; dorsal primary setae long and thin; ventral secondary setae larger and more numerous than on the forelegs.

Tibia ventrally without secondary setae; primary distoventral setae thick, strong, dark; primary posterior subventral seta spinelike; anterior primary seta of midlegs thin, forming a short blunt spinule on the hind legs. Dorsal primary and secondary setae thin. Tarsus without a ventral comb of spinules, with several spinules only at the apex, distoventral primary setae 427 spinelike; distodorsal primary seta forming a short, blunt, black spine, which is curved downward; second dorsal seta thin; there are few secondary setae.

Abdominal segments with a pattern of white dots, which is less rich than on the thorax. Abdominal segment 1 shorter than the others; its dorsal setae are small and light; anterior-angle seta on segments 2 and 3 large; anterior-angle and medioanal setae large on segments 4—8. Both lateral setae on abdominal segment 1 large; numerous long secondary lateral setae in a row on segments 2—8 in addition to the lateral primary setae. The large setae of segment 1 are the lateral and medioventral setae; the intermediate setae on segments 2 and 7 are the largest, and the intermediate and median setae are the largest on segment 8.

Segment 9 (Figure 605) with a small setuliform anterior-margin seta, a posteriorly-displaced anterior-angle seta and 3 surface setae at the posterior margin dorsally on each side sclerite small, light, punctiform; medioanal seta long, dark; intermediate seta thin, small; lateral seta moderately long. Large lateroventral seta on the ventral surface of segment 9 strong, displaced laterally; it is the longest seta of the sclerite; sclerite also with numerous thin secondary setae among which the ventral primary setae (median and intermediate setae) stand out by their length.

Section "a" of anal legs (Figure 605) longer and broader than section "b"; its distal third with an indistinct transverse stripe on the outer side; numerous thin secondary setae of varying length ventrally, distally and laterally. Sclerite of section "b" situated on the outer side, covering the leg laterally, partly dorsally and ventrally; sclerite grayish brown dorsally, lighter laterally, pale yellow ventrally, with indistinct dark dots in some places; basal margin black; a short lobe distally on the outer side; an X-shaped black process for articulation with the claw in the middle. A long dark primary seta above the basal branches of the process (Figure 606); 2 other primary setae of sclerite "b" indistinguishable among the numerous secondary setae of the sclerite and of the membranous surface (Table 10). Section "c" with a light gray small sclerite and a small primary seta near it.

Claw long (Figure 607) narrow, slightly curved; membranous transverse stripe rounded laterally, broad, narrow in the middle, separated by a narrow sclerite from the mediobasal rounded indentation of the claw. Ventrally, beginning at the distal margin of the transverse stripe, there are small spinules which form a continuous row on the outer side; they form rarefied groups on the inner side; rows of spinules converging distally forming a small band of spinules which are longer on the dorsal side. Setae straight, mainly thin, grouped near the basal part of the claw; the long seta 1 on the dorsal side of this part; the short seta 2 situated on the membranous transverse stripe; the shorter, thin seta 5 situated lateral to seta 1; the long, thick seta 3 situated inward; seta 6 long, thin, situated on a membrane; seta 7 absent, replaced by a pit; thin, small seta 8 situated ventrally on a small sclerite, near the base of the membranous transverse stripe; the small, light, thin seta 4 situated basal to it, on the membrane of the mediobasal indentation.

The larva builds a tubular dwelling chamber and a sac-shaped capturing net (Figure 608).

**Young larva.** First stage (Figure 609).* Length 2–3 mm. Ratio of length of head, thorax and abdomen (without anal legs) = 10:16:36. Sutures of head incompletely marked; only the coronal suture and the base of the frontal sutures present, reaching the posterior frontal setae. Upper blade of right mandible with 2 distinct teeth.

Pronotum (Figure 610) without setae on the lateral margin; processes of posterior angles absent; long anterior-angle setae situated at a distance from the margin. Setae of propleuron (seta of trochantin and seta of epimeron) well developed, distinct. Tibia of forelegs shorter than tarsus, without comb of spinules; claw thin, longer than tarsus; seta situated near its middle; a very thin spine basal to the seta; the long primary setae of the forelegs are shown in Figure 610; in the 2nd stage tarsus with ventral comb of spinules; spinule near basal seta of claw absent (Figure 611).

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* Siltala (1907:406, 625, Plate 14, Figure 6, a, c, e, f) gave a short description of the 1st-stage larva of P. conspersa; he gives figures of the 1st- and 2nd-stage larvae on Plate 14; these plates are reproduced here.

Abdominal segments from segment 2 onward with a long anterior-angle and lateral setae; medioanal seta also long from segment 4 onward (Figure 609). Section "a" of anal legs longer than section "b."

**Second stage.** Ventral comb of spinules of fore tarsi present; seta of claw displaced to its base.

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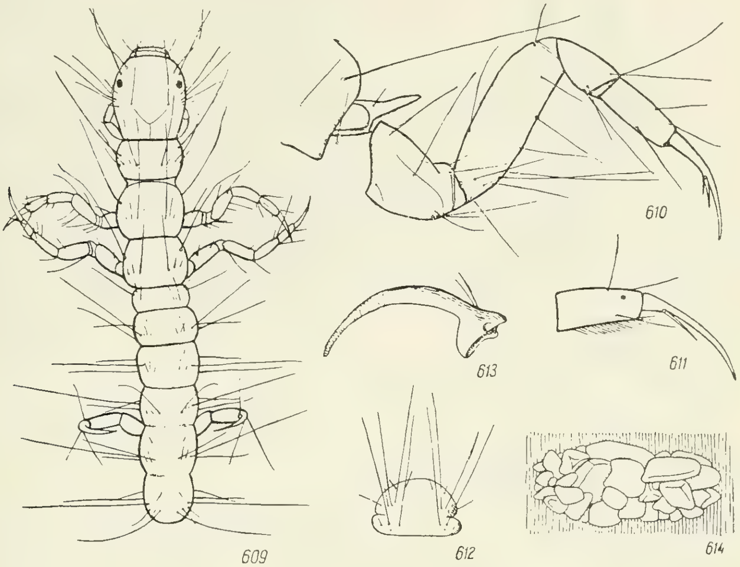

FIGURES 609–614. Plectrocnemia conspersa Curt.:

609 – young 1st-stage larva; 610 – part of pronotum, propleuron and right foreleg of 1st-stage larva, posterior; 611 – tarsus and claw of foreleg of 2nd-stage larva; 612 – anteclypeus and labrum of pupa; 613 – right mandible of pupa, dorsal; 614 – pupal case (609–611 – after Siltala; 612–514 – after Nielsen).

**Pupa.** Length of male pupae 10.0–11.6 mm, of female pupae about 12 mm. Antennae of male pupae reaching abdominal segment 9, those of female pupae segment 6; 1st antennal segment with 3 setae laterally; one or two of them very small. Anteclypeus (Figure 612) convex laterally and with deep grooves separating it from the labrum; lateral seta very small; other 2 setae long; labrum short, with rounded anterior margin and sides; 2 very small light thick setae at the sides of the labrum near the anterior margin; a row of 4 setae posteriorly; the 2 median setae of this group thick and long, almost like the setae on the clypeus; the other 2 setae short, thin; one of them situated near the margin, near the base. Mandibles (Figure 613) sickle-shaped, with broad, short, almost hemispherical base; the long, curved part of the mandible slightly flattened dorsoventrally with finely serrated inner margin; distal part with finely tuberculate surface; outer setae short, of the same length, situated between the apicobasal part.

Wing sheaths reaching middle of segment 4. Mid-tarsus with very thin, light natatorial seta, present dorsally on segments 1 and 2, ventrally only on segment 1. Subapical spurs of the hind tibiae inflated like vesicles, posterior spur larger than the anterior. Claws small and rudimentary.

Gills present on abdominal segments 2–7; gill of segment 2 consisting of one dorsal filament, gills of segments 3–6 of 2 filaments; ventral filament normally developed on segment 7; dorsal filament very small. Plates of holding apparatus light brown, presegmental plates present on segments 3–8, postsegmental plates on segment 5; spinules thin; their numbers as follows: III:3–5; IV:5–7; V:4–7+ 9–11; VI:8–11; VII:5–7; VIII:2–5.

Abdominal segment 9 of male and female pupae with 2 dorsal lobes with numerous stiff setae; male pupae with ventral rudiments of genitalia and broad penis sheath.

Pupae lying in a case (Figure 614) attached to stones or pieces of wood; wall of case thick, covered with small stones or detritus; length of case 17.5–24.0 mm. The pupa lies in a cocoon attached to the walls at the
429 anterior and posterior ends. A horizontal slit about 2.5 mm wide and protected by small stones near the anterior and posterior end. The openings are cleaned with the setae of the labrum and anal legs.

Mode of life and habitats. Small brooks and rivulets with moderately strong current; often on moss, in spring brooks; if the larvae live in rapid streams, they occur under stones, or in concealed places where the current is slow.

Distribution. West, northwest and in the central belt of the European USSR. In addition, Europe.

### 2. **Plectrocnemia latissima** Martynov

Martynov, 1926a:32–33. – Lepneva, 1940:83, Figure 2.*

**Full-grown larva.** Length 22–24 mm. Form of body as in P. conspersa; width of head 2.4 mm. Main color of head brownish yellow; eyes small (Figure 615), situated on a whitish yellow background. Elliptical light figure on frontoclypeus indistinct, sometimes divided. Punctate figure in middle of sclerite oblong longitudinally, open anteriorly; posterior arc of figure consisting of 6 large dots, 2 median dots larger than the others; dots irregularly elliptical, with dark borders; anterior branches of figure consisting of 4 small dots. Short, oblique rows of 3 large dots near the anterior margin of the sclerite; one dot in the anterior angle of the sclerite and anterior to the middle frontal seta.

Dorsal stripes reddish brown, closely adjacent to the frontal sutures and to the anterior part of the coronal suture; stripes broad posteriorly, with large dark dots; outer margin of the stripes, especially in light specimens, indistinct; small dots near the occipital foramen. Lateral stripes broad, with numerous small dots and a few large dots; outer margins of stripes distinct. Ventral surface yellow or light yellow laterally; broadly brownish or reddish brown in the middle; rows of dots, which are arranged obliquely or like a wedge posteriorly (Figure 615, B). Setae as in P. conspersa.

Broad longitudinal stripes of anteclypeus yellowish; spaces between them narrow and light. Labrum (Figure 616) very short, broad; dorsal sclerite brownish; anterior margin with narrow reddish brown borders that are wider at the margin of the median depression; posterior angles of

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* See footnote on p. 101.

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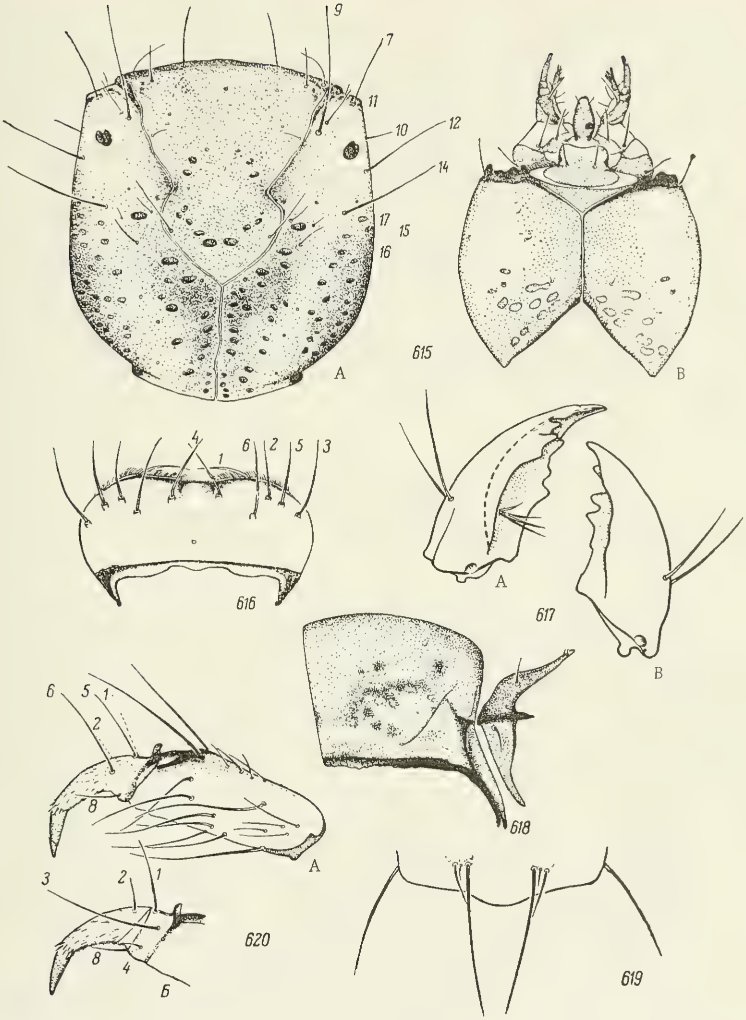


FIGURES 615–620. Plectrocnemia latissima Mart.:

615 – head, dorsal (A) and ventral (B); 616 – labrum; 617 – mandibles, dorsal: left mandible (A), right mandible (B); 618 – pronotum and propleuron; 619 – posterior part of abdominal segment 9; 620 – anal legs: right anal leg, outer view (A), distal part and claw of left anal leg, inner view (B).

sclerite and posterior-angle sclerites reddish brown; posterior margin with a narrow brown stripe; unlike in P. conspersa this stripe is not dark in the middle. Median indentation near the posterior margin. All setae dark as in P. conspersa. Seta 1 transparent, long, strongly curved; setae 4 situated lateral to the median depression; seta 2 situated laterally; setae 6 and 5 situated nearby, near the anterior margin; seta 3 situated laterally, at the margin.

Mandibles (Figure 617) of the form characteristic for the genus, long, flattened, about half as long as head; both mandibles with a deep median depression; upper blade of left mandible with 3 teeth, middle tooth larger than the other two; the 2 basal teeth of the lower blade shorter than the 3rd and closer to each other; 3 long thick chetoids in the median depression. Upper blade of right mandible with one tooth with a small basal denticle in addition to the apical tooth; lower blade with 3 teeth. Outer setae of both mandibles equally long, light, situated close together.

Submentum (Figure 615, B) reddish brown; anterior-angle processes thin and pale; lateral indentations deep; anterior margin slightly dark in the middle; setae brown and thin; posterior margin and outer margin of cardo darker than the other part; stipes with dark brown inner margin; palpifer and palps yellowish. Mentum brown. Setae of maxillolabium as in P. conspersa.

Pronotum (Figure 618) brownish yellow; pattern as in P. conspersa; setae similar. Each half of the sclerite with a dark brown transverse stripe with dots; space posterior to stripe light, bordered by groups of coarse dots; two coarse dots anterior to the stripe. Anterior-angle seta near the margin of the sclerite long, dark, directed anteriorly and slightly laterally; a short dark seta situated slightly more basally; 2 small light setae between these setae. The numerous anterior-margin setae form the following groups: 1) 3 dark brown, relatively thick, long, projecting setae situated near the anterior margin, outer seta longer than the other two and longer than the anterior-angle seta; 2) several moderately long setae, which are lighter and thinner; 3) short, light, thin setae situated between the larger setae. Number of setae in the 3 groups 31—32; there are also very small light setae. Two dark thick setae on the black spot at the lateral margin, one of them long;
430 a reddish brown seta situated at a distance from the spot, another moderately long seta on the spot, near its anterior margin; 2 thin, light setae and one very small seta near it; 2 or 3 short light setae at the margin between the lateral and anterior-angle groups. Surface setae concentrated in two groups; a long dark seta in the median group near the dots; a small light seta on both sides of this seta; a small, thin, dark seta in the anterior quarter of the sclerite.
431 The group on the lateral half of the dark transverse stripe consists of a long, dark seta near the outer margin of the stripe, of 3 thin small setae situated on the stripe and of a small, dark seta situated lateral to the stripe; a small dark seta anteriorly lateral to the spot.

Propleuron (Figure 618) smoke brown on the episternum; trochantin brown; epimeron and its ventral processes yellowish; setae as in P. conspersa.

Legs as in P. conspersa. Forelegs chestnut brown; coxa lighter than trochanter and femur; tibia, tarsus and claw darker. Midlegs and hind legs yellowish; hind legs paler than midlegs. Dots near base of coxae indistinct or absent. Anterior basodorsal seta of fore coxa thin, long, lighter and much longer than the 3 strong spinelike dark brown setae at the anterior margin of the dorsodistal indentation; posterodorsal seta situated in the middle of the margin of the depression.

Patterns of dorsum of abdominal segments as in P. conspersa, consisting of a continuous or punctate white stripe on the sides of the segment, of a similar transverse stripe in its posterior half and of 2 pairs of dots in the middle of the segment. Dorsal anterior-angle setae of abdominal segments 2—8 large; they are situated in the middle of the segment in the anterior part of the abdomen; they are situated near the posterior margin and long on segments 7 and 8; surface setae, including the large medioanal seta situated near the light transverse stripe; one of the 2 lateral setae of segment 1 almost twice as long and as thick as the other; numerous secondary lateral setae of the following segments, among which the primary setae are indistinguishable, of varying length and thickness; medioventral seta on segment 8 shorter than intermediate seta.

Dorsoanterior margin setae on segment 9 short and thin; distinct, medioanal setae long, dark, situated near the margin of the small pale sclerite (Figure 619); intermediate and lateral setae small and thin; anterior-angle seta smaller than anterior-margin seta; lateroventral seta strong, dark and situated on the sides of the segment; the numerous secondary ventral setae of the segment reddish brown; 4 or 5 of them thick and long.

Anal legs (Figure 620) as in P. conspersa; section "a" longer than section "b." Setae of section "a" situated in its basal part, only ventrally, situated ventrally and laterally in the apical part; setae stiff, straight, blackish or reddish brown, few in number on the inner side, more numerous on the outer side.

Dorsolateral sclerite of section "b" pale yellow (Figure 620, A), smoke brown near the base, with a black margin; small dark lateral and dorsal lobes situated at the curvature near the apex; stripes of distal X-shaped articular part of sclerite black in the middle, brownish at the margin. Distodorsal primary setae strong, blackish brown, the longest setae of section "b"; 9 thick dark setae at the lateral margin, which are also long but shorter than the distal setae; 3 setae situated behind each other near the basal margin; one almost as long as the distal setae; the black margin ventrally has a dark, curved seta which extends to the middle of the claw; sclerite of section "b" with short and small, thin setae; membrane with several small light setae. Claw (Figure 620, B) as in P. conspersa, with a comb of small delicate spinules ventrally; spinules of subapical band thin, little marked; setae as in P. conspersa; mediodorsal seta 3 longer and thicker than the others; seta 8 thin, light and short.

**Pupa.** Length of female pupae 12 mm. Antennae reaching segment 6. Labrum as in P. conspersa; setae similar: 2 long strong setae and 4 small setae; anteclypeus with 2 long setae and a small lateral seta. Longer setae of labrum and clypeus dark, reddish brown, curved, crossing each other, forming the setae of the cleaning apparatus; outer setae of mandibles also forming part of cleaning apparatus.

Mandibles reddish yellow; their sickle-shaped part thin and long; mandibles cross each other at rest, reaching to the middle of the eye;

apical part of mandible covered with tubercles, which occupy more than half its length; basal part convex, less broad than in P. conspersa.

Wing sheaths extending to abdominal segment 4. Natatorial setae on segments 1 and 2 of mid-tarsi; unlike in P. conspersa, they are present on the dorsoventral side of both segments; ventral setae of second segment very small.

Presegmental plates of holding apparatus present on abdominal segments 3—8, postsegmental plates on segment 5; number of spinules as follows: III:4; IV:4; V:4 + 7; VI:6; VII:4; VIII:5; plates concave like cups;
432 spinules present at distal end of plate. Segment 2 with only one dorsal gill filament; segment 3 with two equal filaments, one dorsal and one ventral; dorsal filament on segments 4—7 shorter than ventral filament; dorsal filament on segment 7 only about half as long as ventral filament.

Anal lobes broadly oval, with numerous black or brownish black setae; ventral median process of abdominal segment 8 of female pupae slightly longer than in P. conspersa, with an apical saddle-shaped indentation.

Length of pupal case 23—30 mm, width 8—9 mm; walls covered with detritus; ventral surface covered with grayish tissue. Pupa lying in a cocoon of loose tissue.

Mode of life and habitats. Mountain rivulets, brooks and springs, in various biotopes, on stones and among stones, on the usually stony bottom.

Distribution. USSR: Ciscaucasia, the Central Caucasus, Transcaucasia. In addition, Iran.

## 2. Genus Polycentropus Curtis

**Full-grown larva.** Length 12—14 mm. Head oblong, with almost parallel sides; head light yellow, with distinct punctate and shaded pattern. Labrum without pattern; setae thin. Pronotum with characteristic but not always distinct dots; dark brown posterior margin relatively narrow; anterior-angle seta strong, much shorter than anterior-margin setae. Tarsi, especially on the forelegs, short; claws thin, slightly curved, longer than tarsi; ventrodistal setae of tibiae long, dark, spinelike, thick, almost reaching base of claw; tarsi of forelegs with dense thin feathered setae near the apex. Dorsal setae on sides of segment 9 small, smoke brown; a small indentation laterally; sclerite with a long medioanal seta, a small intermediate seta and a short lateral seta near the sclerite. Anterior-angle seta indistinguishable, setuliform. Anal legs long; section "a" longer and broader than section "b"; transverse stripe in the distal quarter little marked; dorsolateral sclerite of section "b" usually light, with or without indistinct dots; primary disto-dorsal setae long, dark; secondary setae numerous. Claw thin, long, bent at almost a right angle; spinules of ventral comb very small; 1—2 longer spinules on the distal band, projecting above the claw, giving the impression of a dorsal denticle as was erroneously described and illustrated by Siltala (1903c:12, Figure 4, a) and Ulmer (1909:230, Figure 353, d).

**Pupa.** Length 6—8 mm. Antennae of male pupae reaching end of abdomen; those of female pupae segment 6. Clypeus with 2 long setae and a short lateral seta on each side; labrum with 2 long and 4 short setae; setae longer than in Plectrocnemia.

Wing sheaths reaching end of abdominal segment 5. Natatorial setae present on fore and mid-tarsi. Presegmental plates present on segments 2 and 8, small, with 5 or 6 straight spinules; postsegmental plates curved, situated near the posterior margin of segment 5, with numerous spinules. Gills present on segments 2—7. Anal lobes rounded, with numerous setae.

Walls of case loose, with a covering of sand grains or detritus, pupa lying in a cocoon of gray loose tissue.

Mode of life and habitats. Larvae predacious, free-living, building capturing nets; they occur in running water and on lakeshores.

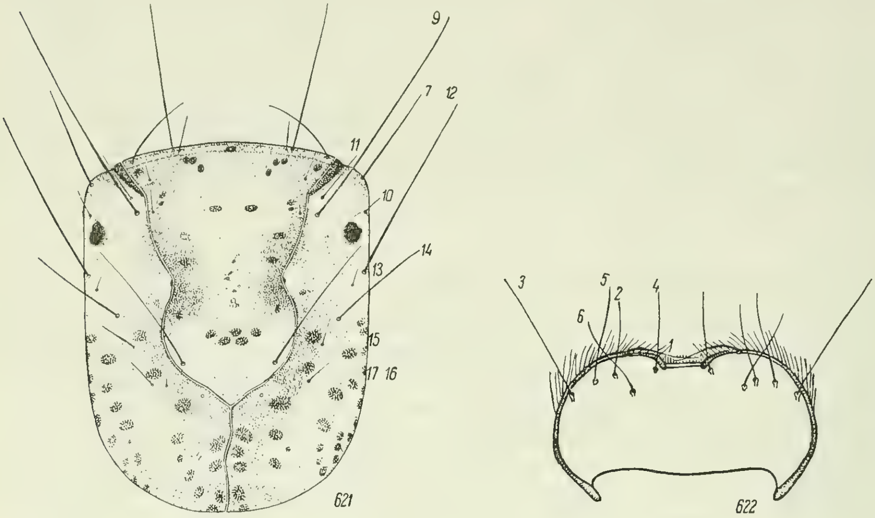
Distribution. European USSR, the Caucasus, Western and Southern Siberia, Middle Asia. In addition, Europe, Africa, northwest China, Iran, North America, South America (Argentina).

### 1. **Polycentropus flavomaculatus** Pictet

Pictet, 1834:220—221, Plate XIX, Figure 2.— Klapálek, 1888:54—56, Figure 19.— Struck, 1903:119, Plate IV, Figure 2.— Ulmer, 1903:119, Figure 70,— Siltala, 1903c: 12, Figure 4; 1905:124—125; 1907:404—406, Figure 6, d.— Ulmer, 1909:230, 297, Figure 355, b.— Lestage, 1921:491—494, Figure 159.— Lepneva, 1940:201, 205, Figure 152, 4.

**Full-grown larva.** Length 12—13 mm. Head oblong-elliptical, dorsoventrally compressed (Figure 631). Eyes large, consisting of 6 facets
433 arranged in a ring at about a fifth of the head from the anterior margin. Head light yellow. Frontoclypeus slightly dark anteriorly; sides of anterior part with narrow grayish brown stripes close to the margin; in dark specimens, the stripes on both sides are broader posteriorly and almost converge, forming a small dark band near the curvature of the frontal sutures; this band is little marked in light specimens. Anterior and curved rows of dark dots, which form an elliptical punctate figure, anterior and posterior to the band; anterior arc with 6 dots; posterior arc with 6 or 7 dots, which are larger in the middle; a small lateral dot on the posterior end of the dark lateral stripe. Posterior angle without pattern posterior to the punctate figure; it forms a light heart-shaped spot on the dorsal surface. Lateral anterior-margin seta in the anterior angle light, curved; intermediate seta straight, dark, long, situated at a marked distance from the lateral seta, near a small thin median seta (Figures 621, 623); antero- and middle frontal setae short, thin, situated behind each other in the anterior part; posterofrontal seta is one of the longest setae of the head, dark, situated near the suture, on the light, heart-shaped figure.

Dorsal stripes close to the margin, beginning from the clypangulus, extending to the middle of the coronal suture, where the stripes of both sides are connected; stripes narrow anteriorly; they are interrupted near the curvature of the frontal sutures, broad posteriorly, with large and small dots; 2 dots along the frontal suture one behind the other; 2 smaller dots near the coronal suture; groups of small dots posterior to the stripes near the occipital foramen; lateral stripes replaced by longitudinal rows of dots. Seta 9 straight, longer than the others; seta 11 thin and dark, slightly longer than the anterofrontal seta situated near seta 9; dark seta 7 situated near the anterior margin, shorter than seta 9; the short light, slightly curved seta 10 situated lateral to the eye; small seta 13 and the long brownish black seta 12, which is the thickest seta of the head, posterior to the eye; setae 14 situated at about the midlength of the head; setae 15 and 16 thin and small, light, situated behind each other lateral to the 2nd and 3rd spots of the dorsal stripes; seta 17 situated near the second spot, smaller than seta 16.



FIGURES 621 and 622. Polycentropus flavomaculatus Pict.:

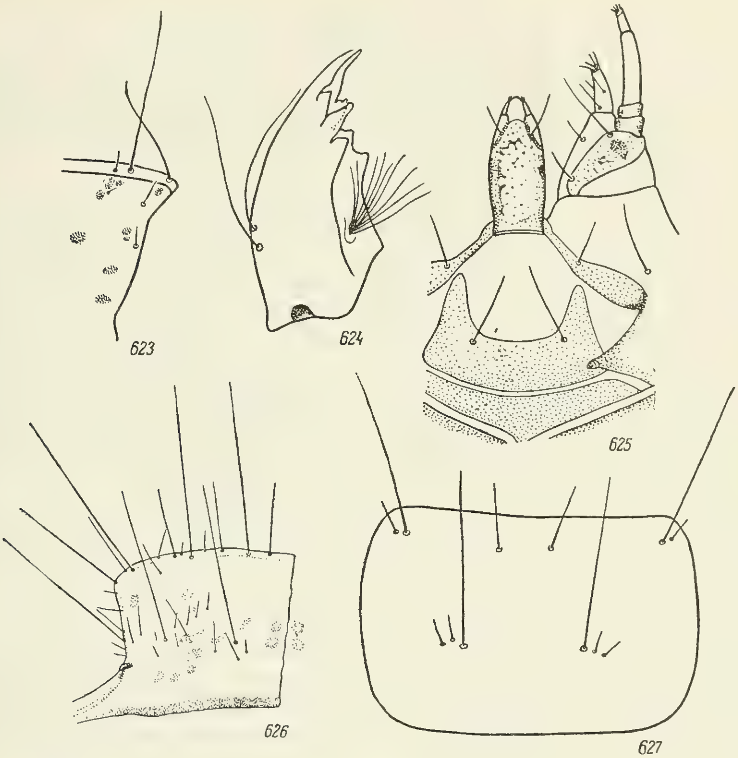
621 – head, dorsal; 622 – labrum.

Head light ventrally; a group of small dots and an oblique row of larger dots which reach almost to the middle of the gular suture on both sides of the occipital foramen. Seta 8 small, light, situated near the anterior margin; seta 18 little marked, setuliform, situated posteriorly. Gula short, broadly triangular, with almost straight anterior margin, yellowish, situated outside the head capsule.

Anteclypeus light, with 3 broad grayish longitudinal stripes. Labrum (Figure 622) of the form characteristic for Polycentropodidae, but less short than in Plectrocnemia; dorsal sclerite golden yellow; posterior angles 434 and posterior-angle sclerites yellowish brown; setae as in Plectrocnemia; setae 1 slightly shorter than in Plectrocnemia; seta 3 longer. Mandibles (Figure 624) long, mainly yellowish, reddish brown near the teeth and blades; narrow basal margin of mandibles and articular tubercles brownish. Apical tooth of left mandible narrow, pointed, markedly projecting; upper blade with 3 teeth; lower blade with 3 almost equally long teeth; median depression with a brush of 6–7 chetoids, some of them long. Upper blade of right mandible with a large tooth with a denticle near it; lower blade with 3 distinct teeth and a subapical indistinct tooth in addition to the apical tooth.

Maxillolabium light yellow (Figure 625). Submentum shorter and broader than in Plectrocnemia; anterior-angle processes narrow, dark; setae thin, light and strong; seta of cardo situated near the basal margin, brownish;

stipes with a light brown median margin; apical outer seta situated on a sclerite and basal seta longer, situated on the membrane; maxillary palp and galea with thin, light yellow sclerites; mentum brownish, with a pointed median process; sclerites of labial palpifer delicate, light yellow; setae of ventral sclerites thin, light; labial palps small, adpressed to the ligula.



FIGURES 623–627. Polycentropus flavomaculatus Pict.:

623 – part of frontoclypeus; 624 – left mandible, dorsal; 625 – maxillolabium; 626 – pronotum; 627 – mesonotum.

Pronotum (Figure 626) yellow, of the same form as in Plectrocnemia, slightly longer, posterior margin black or brownish black; stripe of posterior-angle process brownish, dashlike; a small blackish brown spot in the middle of the lateral margin; anterior margin of sclerite light, lateral
435 margin narrowly dark anteriorly. Dots reddish brown, not as distinct as on the head. Two dots behind each other lateral to the suture in the middle. Two dark transverse dots lateral to these dots, near the base of the median seta; group of dots in the middle of each half of the sclerite forming a longitudinal, slightly curved row, which continues posteriorly in a short curved transverse row. Setae at the anterior margin of varying length, 15 or 16 in number, reddish brown and yellowish; anterior-angle seta thick, dark, shorter than the lateroanterior-margin seta; short, thin, light seta between

the two above setae; lateral margin with 2 brown setae near the anterior-angle seta; one of them setuliform; a brown strong seta and 2 small setae near the dark spot of the margin of the lateral margin. A long seta and 2 small thin setae in the posterior third of the sclerite; several small setae in the middle of each half; posterior seta dark, longer and thicker than the others; a long reddish brown seta laterally; other surface setae thinner and smaller.

Propleuron very large, as in all Polycentropodinae, mainly yellow; trochantin and its hornlike process brownish; pleural suture and adjacent part of distal margin of epimeron blackish brown. Trochantin situated at the apex of a process with a small membranous sucker-shaped process with 2 light setules at the base; seta at base of trochantin brownish and thin; small seta of epimeron situated near the suture.

Meso- (Figure 627) and metathorax broader than prothorax; both segments of about the same size. Pale pattern on dorsum of segments consisting of 2 longitudinal white stripes and a coarse white spot lateral to them; several small white dots more medially. Anterior-margin setae of both segments situated near the margin of the white stripes shorter on the metathorax than on the mesothorax; anterior-angle setae thin, almost as long as the segment; medioanal setae similar, situated in the posterior third of the sclerite, near the white stripes; a small intermediate seta and a small lateral seta near them; Meso- and metapleuron forming a yellow, long plate with a narrow dark groove, with a dark distal margin, which belongs to the episternum, which is fused with the trochantin (it occupies the greater part of the pleuron); epimeron small, yellowish; seta of epimeron situated on a membrane near the margin; seta of episternum situated in the angle between the pleural suture and the dark distal margin.

Forelegs shorter than the other legs; hind legs slightly longer than midlegs; legs yellow; dots on legs indistinct.

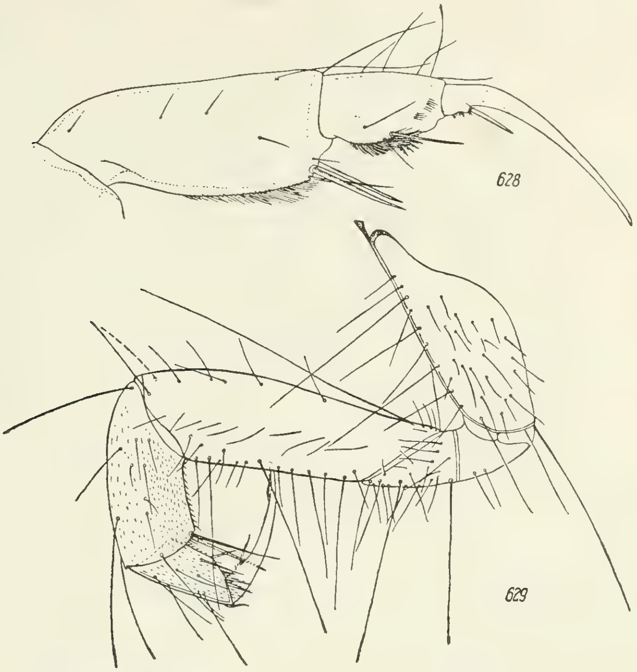
Coxa of forelegs with a distodorsal indentation which reaches the middle of the segment; most setae brown or dark brown; basoanterior dorsal seta long; apical seta at margin of indentation spinelike and thick; posterodorsal seta thin, longer than the other two, situated in the middle of the margin of the distodorsal indentation; a thick spinelike seta situated nearby, on the anterior surface; this seta resembles the distodorsal seta; 2 small setae near this seta; numerous short setae on the posterior surface and a row of spinelike setae among them; dark posterior distoventral seta twice as long as anterior seta; a few strong secondary setae on the ventral surface, at the margin anteriorly and posteriorly.

Posterior seta of trochanter dark, long, situated subapically; anterior seta short, strong, dark, situated near the apical margin; ventral setae thin, light, numerous; the thin subapical posterior seta of the 5 primary setae stands out by its length; it is the longest seta of the segment; distoventral seta also long.

Ventral surface of femur straight in profile, smooth; dorsal surface slightly convex. Primary dorsal setae thin, dark; basal seta much longer than the slightly posteriorly displaced distodorsal seta; secondary dorsal setae absent; anterior surface with a row of short secondary setae in the middle, which are mainly strong and dark; this row contains subapically a thick primary anterior seta forming a strong, long, blackish brown spine;

a row of sparse secondary setae subdorsally; posterior surface of femur with sparse short secondary setae; a row of strong setae, 2 of which are longer than the primary setae ventrally.

(436)



FIGURES 628 and 629. Polycentropus flavomaculatus Pict. Legs: 628 — tibia, tarsus and claw of anterior right leg, posterior; 629 — right midleg, anterior.

Tibia (Figure 628) curved in the basal part, narrower than apically; dorsal margin straight in the other part; ventral margin slightly convex, with a comb of spinules. Ventral surface with microscopic spinules which partly cover the anterior side. Both distoventral setae form thick, long, blackish brown spines; posterior spine slightly longer than anterior spine; anterior seta near the ventral setae also forming a spine, but much smaller; short posterior seta near the ventral setae, thin and strong, light
436 brown; several thin setae dorsally; two primary setae among these setae; a subdorsal longitudinal row of 4 brownish setae anteriorly; a curved row of 5 strong spinelike setae which are smaller than the anterior primary seta in the same row; several thin and thick short setae apically and subapically; a light, curved, spinelike seta subapically in the ventral row of the spinules; 3 long, hairlike setae on the posterior surface, in about the middle of the segment.

Tarsus (Figure 628) short, tibia 2.5 times as long as tarsus; distoventral indentation of tarsus deep, with dense feathered spinules at the margin;

a comb of spinules on the ventral side; a few microscopic spinules ventrally and anteriorly; distal margin also with small setae and spinules; a flattened chetoid, which is digitate apically, subapically near the dorsal margin. Primary ventral setae thick, spinelike, situated lateral to the comb; anterobasal seta light, feathered; posterior seta situated near the middle of the comb, dark, with a long thin end. Distodorsal primary seta short, dark, curved, recumbent. Other dorsal setae, including second primary seta sparse, thin, situated at the dorsal margin; one subapical seta curved, recumbent.

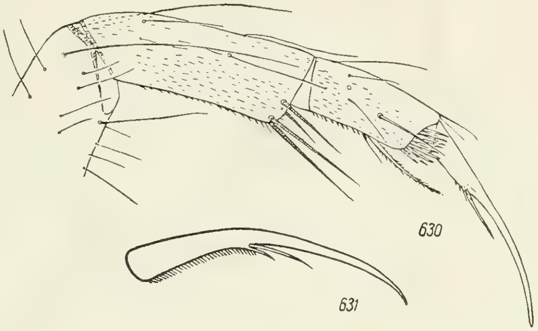
Claw thin, long, slightly curved, more than twice as long as tarsus; seta of claw spinelike, with thin, light, needle-shaped spinules near the base; a small, pectinate process with apical spinules basal to the seta.

Coxae of midlegs (Figure 629) and hind legs with a long dark brown process at the basal margin; this process has a narrow, reddish black margin and a small articular process contiguous to the pleuron beyond it;
437 dark background near the basal margin with 2 or 3 indistinct large spots. A continuous row of 7 dark, strong setae and 2 light setae anteriorly, near the distodorsal indentation on the midlegs; 2 primary setae longer than the others; hind coxa with 4 setae near the distodorsal depression; two of these setae (primary setae?) longer and thicker than the others; this row contains 3 additional thin setae further basally; posterodorsal seta thin, brownish, longer than on the forelegs. Anterior and posterior surfaces of coxa with short secondary setae, which are more numerous on the midlegs and sparse, lighter and thinner on the hind legs; one seta situated subapically and anteriorly longer than the others; coxa without secondary setae ventrally; posterior distoventral seta dark and long; anterior seta much shorter and thinner (Figure 629).

Basal segment of trochanter of midlegs with short thin setae, that of hind legs with three similar setae, which are slightly longer; numerous secondary setae of 2nd segment of both legs thin, light; several primary setae stand out by their length, especially the subapical ventral seta.

Mid-femur shorter than hind femur, with slightly convex dorsal margin; hind femur long and rodlike, its dorsal and ventral margin almost parallel. Dorsal narrow surface of both legs without secondary setae; primary basodorsal seta at base of segment long; distodorsal seta shorter, dark reddish brown, displaced posteriorly and directed slightly laterally; primary posterior seta situated near the ventral margin, of the same form as the distodorsal seta but much shorter, thinner on the midlegs than on the hind legs; anterior primary seta situated distally near the dorsal margin, shorter on the midlegs than on the hind legs. Secondary setae of anterior and posterior surface of midlegs especially numerous, shorter and stronger than on the hind legs; they form a longitudinal row in about the middle of the segment anteriorly and subdorsally, where the setae are thinner and sparser; a row of long secondary setae of different length ventrally which are longer on the midlegs; both primary setae situated among them.

Mid-tibia shorter than hind tibia; mid-tibia brownish, hind tibia yellow; both tibiae covered with setuliform spinules; a comb of short spinules ventrally. Secondary setae not numerous; anterior part subdorsally with a row of thin setae that are shorter on the midlegs; setae directed apically; 4 longer similar setae dorsally, 2 of which are primary. Anterior seta of tibia of midlegs strong and dark, that of the hind leg spinelike, close to the ventral setae; posterior seta spinelike, shorter than anterior seta, that on the hind legs situated near the ventral setae; posterior seta spinelike, shorter than the anterior seta; seta on hind legs situated near the ventral setae. Two massive primary setae ventrally at the apex which form thick, long, dark spines; anterior seta slightly longer than posterior seta.



FIGURES 630 and 631. *Polycentropus flavomaculatus* Pict.:

630 — distal part of left hind leg, anterior; 631 — claw of foreleg of 2nd-stage larva (after Siltala).

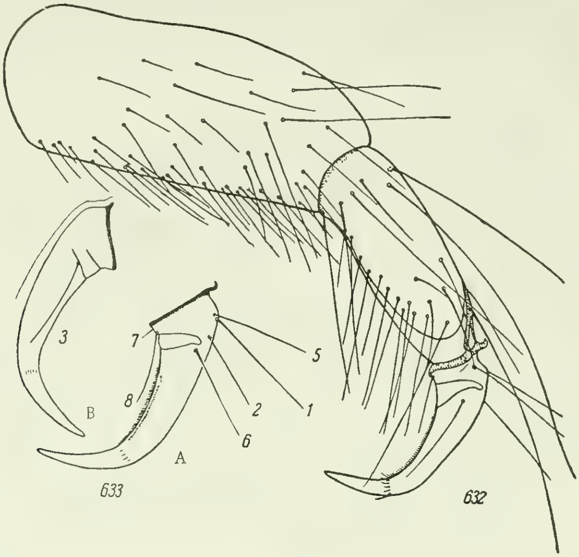
Mid-tarsus shorter than hind tarsus (Figure 630); tarsi of both legs with microscopic spinules; ventral side of tarsus with a small comb of spinules; tarsus with flat chetoids feathered at the apex which are less numerous than on the forelegs. Dorsodistal seta small, dark, slightly curved, recumbent; other 4 setae of the dorsal margin thin; anterior surface with thin secondary setae; ventral primary setae brownish yellow, thick, spinelike, thinly
438 feathered, situated far subapically lateral to the comb.

Claw as on forelegs, thin and slightly curved, with small spinules at the base. A large spine near the seta in larvae of the 1st and 2nd stages (Figure 631).

Abdomen uniformly broad in its greater part; segment 1 shorter and slightly narrower than the following segments; segment 4 narrow. Dorsal side of abdomen with delicate white pattern consisting of a longitudinal stripe, a narrow lateral stripe and two oblique stripes in each half of the segment. Anterior-margin seta of segments 1—6 light and small, slightly larger on segments 7 and 8; Anterior-angle seta of segment 1 small; it increases in size from segment 2 onward and is situated about the middle of the segment; it is situated posteriorly on segments 7 and 8; medioanal seta of segments 2 and 3 small, that of segments 4—8 large, situated near posterior margin; a small intermediate seta and a small lateral seta near it. Setae of pleural region of segment 1 two in number, situated behind each other; segments 2—8 with the primary setae and with a row of long, thin secondary setae that form a longitudinal lateral row (spurious lateral line); one of the ventral setae long on segments 1—8.

Only the medioanal seta of segment 9 long; anterior-angle seta much smaller, thin, situated in the same row; intermediate and lateral seta very small. Two ventral setae long, one situated on the sides of the segment, dark and thick; ventral side with groups of thin, light, secondary setae in addition to the primary setae.

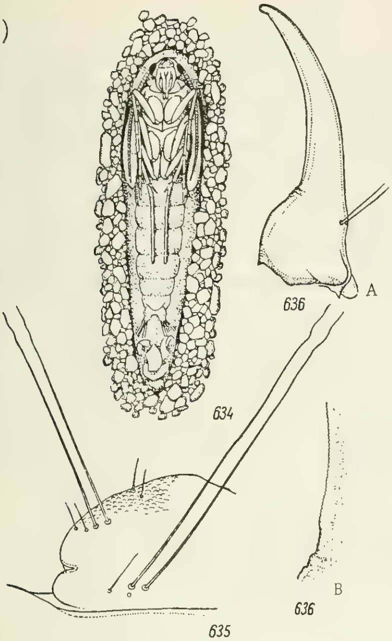
(439)



FIGURES 632 and 633. Polycentropus flavomaculatus Pict.: 632 – left anal leg, outer view; 633 – claw of left anal leg, outer view (A) and inner view (B).

Anal legs long (Figure 632). Section "a" much longer than section "b"; fold in the distal third of section "a" distinct; secondary setae numbering 90, thin, light, mainly present ventrally; a longitudinal row of a few short setae on the outer side of section "a"; near the transverse fold and closer to the margin are thin, longer, subapical setae. Sclerite of section "b" light yellow, with reddish brown basal margin; basal third of sclerite dorsally with 2 indistinct grayish brown spots; articular rods dark brown; distal margin of sclerite smoke brown, with 2 processes: a narrow, downward-curved, ligulate process between the rods, and broadly oval, lateral process. Two long, brown, primary setae distodorsally, near the base of the rods; a regular row of 9 long, dark setae distally and ventrally, at the outer margin of the sclerite; 3 short, light setae basal to the last seta and between the 2 penultimate setae in some specimens; basoventral corner of sclerite with a dark brown, strong, long seta which is longer than the sclerite; surface of sclerite with a long, dark, brown, strong seta and a thin shorter seta dorsally, near the base on both sides; a long, dark, thick seta and 2 thin, relatively short setae laterally near the base; apical part of sclerite with several thin, moderately long and small setae.

Claw (Figure 633) narrow, curved with 2 rows of small, light spinules ventrally; subapical band with 1 or 2 strong, longer projecting dorsal spinules. Setae concentrated in the basal part; setae 1 and 5 situated dorsally near the base of the claw; setae 2 and 3 situated closer to the transverse stripe; seta 6 situated laterally near the membranous transverse stripe; setae 3 and 6 brown and relatively long, thick; seta 2 short and thin; seta 8 (440) spinelike, light, relatively large, situated near the basal margin of the membranous transverse stripe; small, thin seta 4 situated near the basal margin; seta 7 absent.



FIGURES 634–636. Polycentropus flavomaculatus Pict.:

634– pupa in its case, ventral; 635 – labrum of pupa; 636 – right mandible of pupa, dorsal (A); part of blade near distal part (B).

**Young larva.** The number of stages of P. flavomaculatus is not exactly known; there are probably 5 stages. Siltala (1906:404–406, 408) observed 4 molts of P. flavomaculatus in an aquarium; Siltala adds a 6th stage, "full-grown larva," which he described from larvae collected in nature; he gives the following differences from the 5th stage: dark spots at the base of the large setae of the meso- and metathorax* and a difference in the number of secondary setae. As it is difficult to count the small setae, and as there are probably variations in the number of secondary setae (especially in an aquarium), we cannot consider proven the existence of a 6th larval stage. We give here only some remarks on the first 4 stages, which were described briefly by Siltala (1907:404–406).

**First stage.** Length 1.8–3 mm. Head broad, higher than body at beginning of stage; this difference disappears at the end of the stage; epicranial suture
439 marked only in the basal part, including the bifurcation of the frontal sutures. Sclerites light yellow; pattern absent; setae relatively long. Thoracic segments equally broad; pronotum without posterior-angle processes. Ratio of length of tibia, tarsus and claw of all 3 legs 100:100:127, 86:100:119, 86:100:119. Claws thin, slightly curved; ventral seta situated in about the middle of the claw; a row of microscopic spinules basal to the seta; spinule at base of seta larger than the others, as in the 2nd stage (Figure 631).

Section "a" of anal legs shorter than section "b."

**Second stage.** Length 2.4–4.3 mm. Head with indistinct stripes and dots. Processes of hind angles of pronotum present; ratio of length of tibia, tarsus and claw of 3 legs 125:100:140, 116:100:140, 107:100:129; seta of claw situated further basally than in 1st stage. Dorsum of thoracic and abdominal segments with an indistinct pattern of light lines.

**Third stage.** Length 4.5–6 mm. Dorsal pattern of head almost as in the full-grown larva, indistinct ventrally. Ratio of length of tibia, tarsus and claw of the 3 legs 150:100:150, 130:100:130, 126:100:117.

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* I did not find these spots in the full-grown larvae of P. flavomaculatus at my disposal.

**Fourth stage.** Length 7–8 mm. Pattern of head and pronotum almost as in full-grown larva; ratio of length of tibia, tarsus and claw of all 3 legs 183:100:158, 140:100:126, 133:100:122 (240:100:166, 205:100:147, 154:100:136 in the full-grown larva).

**Pupa.** Length 6.0–8.3 mm. Antennae moniliform at the end, reaching abdominal segment 6 in female pupae, in male pupae end of the body (Figure 634). Anteclypeus (Figure 635) short, separated from labrum by a shallow, distinct fold; labrum small, semicircular; median and intermediate setae of anteclypeus and 2 setae of labrum (Figure 635) long, straight, with thin, transparent, sinuous ends; other setae small. Mandibles (Figure 636) sickle-shaped but less long than in *Plectrocnemia*, less curved; base less broad than in *Plectrocnemia*; end of the mandibles reaching inner margin of eye when folded; base light yellow on the outer side; blades brown outer setae short.

With sheaths broad, with rounded ends, reaching beginning of abdominal segment 5. Spurs of midlegs and hind legs of different length; first 3 tarsal segments of midlegs dorsoventrally with relatively long, light, dense setae. Presegmental plates present on segments 3–8, postsegmental 440 plates on segment 5; number of spinules of male pupae as follows: III:3–4; IV:4–4; V:5–6 + 8–10; VI:8–9; VII:4–5; VIII:3–4.

Gills filiform, present on segments 2–7; gill of segment 2 with only a dorsal branch; gills of segments 3–4 with a dorsoventral branch; dorsal branch short on segments 5 and 6, absent on segment 7.

End of body dorsally with two broad, rounded lobes with long, strong, dark or golden brown setae; male pupae ventrally with the sheath of the genital appendages and a broad penis sheath; female pupae with a medioventral conical process on segment 8; process blunt and slightly divided at the end.

Walls of pupal case loose, covered with fine sand grains; ends of case with small filtering sieves of delicate tissue; pupa lying in a sheath of loose grayish tissue.

*Mode of life and habitats.* Predacious, building capturing nets; brooks and rivulets with cool water; mainly on stony or sand-stony bottom, also in lakes among stones along the shore.

*Distribution.* Northern, western and central regions of the European USSR; south of West Siberia. In addition, Europe, North Africa.

### 3. Genus *Holocentropus* McLachlan

**Full-grown larva.** Length 13–16 mm. Form of body as in *Polycentropus*. Head yellowish, slightly broader posteriorly than anteriorly, with a punctate and shaded pattern. Frontoclypeus usually light in the middle. Dorsal stripes present. Gula fused with pregula, broad, slightly longer than in the preceding genera.

Pronotum with punctate pattern; shaded pattern absent. Midlegs and hind legs longer than forelegs. Tarsi longer on the forelegs than the tibia, of the same length or slightly shorter on midlegs and hind legs; ventrodistal setae of tibia spinelike but less dark, large and projecting as in

Polycentropus; apex of tarsus of all 3 pairs of legs with a crown of spinules; claws thin, slightly curved; almost as long as tarsi on midlegs and hind legs.

Anal legs thin at the end; setae of section "a" relatively long, not shorter or slightly shorter than the secondary setae of section "b." Claw thin, bent at almost a right angle at the end; subapical band of spinules distinct; 2 or 3 dorsal spinules larger than the others.

**Pupa.** Length 6.5–10 mm. Antennae reaching segments 5–8. Labrum with rounded anterior margin, sometimes with a small median process, with 2 long and 4 short setae. Mandibles sickle-shaped, less strongly curved than in Plectrocnemia, with blunt end. Wing sheaths reaching segments 5–6; first 4 segments of fore and mid-tarsi (sometimes also of hind tarsi) with natatorial setae. Presegmental plates on segments 3–8, with 4–6 denticles; postsegmental plates on segment 5 with 8–12 denticles. End of body with broad, rounded anal lobes; segment 8 of females with a conical ventral process.

Pupal case made of loose tissue, covered with sand grains or small stones; anterior and posterior end with filtering sieves. Pupa lying in a cocoon of loose tissue.

441 Mode of life and habitats. Larvae predacious, building capturing nets; mainly living in stagnant water, in plant thickets in lakes and floodland water bodies, also in plant thickets in rivers and rivulets with a slow current.

Distribution. European USSR, the Caucasus, Siberia, Kamchatka. In addition, Europe, northern Mongolia.

Key to Species

Full-grown larva

1 (4). Dorsal stripes of head distinct, extending almost to the posterior margin; frontoclypeus light in the middle.
2 (3). Transverse row of dots in the posterior part of the frontoclypeus absent, or only indistinct marginal dots present; sclerite light anteriorly in the middle . . . . . . . . . 1. **H. picicornis** Steph. (p. 500)
3 (2). Transverse row of dark dots present in posterior part of frontoclypeus; sclerite slightly dark near the posterior margin . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **H. stagnalis** Alb. (p. 508)
4 (1). Dorsal stripes indistinct, extending from anterior margin to middle of head; frontoclypeus dark anteriorly and posteriorly, only an area in the middle light . . . . . . . . . . . . . . . 3. **H. dubius** Ramb. (p. 508)

Pupa

1 (4). Labrum a median anterior process; all 3 setae of clypeus long. Hind tarsi with natatorial setae; ventral process of segment 8 of female pupae relatively long, with a saddle-shaped indentation at the end.

2 (3). Anal lobes, especially of female pupae, very short; penis sheath short . . . . . . . . . . . . . . . . . . . . . . 1. **H. picicornis** Steph. (p. 500)

3 (2). Anal lobes as in the other genera, relatively long, slightly narrower; at the end; penis sheath longer than in H. picicornis . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **H. stagnalis** Alb. (p. 508)

4 (1). Labrum rounded anteriorly; anterior seta of clypeus much shorter than the other two. Hind tarsi without natatorial setae; conical ventral process of segment 8 of female pupae short, without indentation . . . . . . . . . . . . . . . . . . . 3. **H. dubius** Ramb. (p. 508)

### 1. **Holocentropus picicornis** Stephens

Struck, 1899:342, Figure 29; 1900:27, Figure 47. — Ulmer, 1901:200—202, Figures 1—8; 1903:120, Figures 79, 124. — Struck, 1903:119, Plate IV, Figure 3. — Siltala, 1903c:13; 1905:125—127, Figures 31, 32. — Thienemann, 1905b:539—540. — Figures 85—87. — Ulmer, 1909:230—231, 297, Figure 355, c.— Lestage, 1921:496—502, Figure 162, c, d, h, i, k. — Lepneva, 1940:205.

**Full-grown larva.** Length 14—16 mm. Head (Figure 637) yellow, with distinct pattern. Frontoclypeus with dark lateral stripes, which are slightly broader anteriorly; stripes smoke brown anteriorly; stripes dark brown and narrow near the curvature of the frontal sutures, with three large dark dots situated behind each other; they are brownish posteriorly, separated by a light space from the dark part of the middle; sclerite light in the middle including the posterior angle; transverse row of dots absent or indistinct posteriorly, consisting of only 1 or 2 lateral dots.* Latero-anterior margin seta transparent, curved inward; intermediate and median seta situated at a distance from the lateral seta; both setae thin; intermediate seta relatively long; lateral seta short, situated near the margin; 3 dark dots posterior to it; anterior frontal seta thin, short, situated at posterior angle of clypangulus; middle seta situated slightly farther posteriorly, small; posterior frontal seta brownish black, long, situated near suture at end of dark lateral stripe.

Clypangulus dark brown; brown, dorsal stripes extending from the anterior margin to the occipital foramen, where they become narrow; a light spot between dorsal stripe and frontal suture (at the curvature of
442 the suture) remains; small and larger dark dots present in the posterior part along the stripes; lateral stripes also replaced by rows of dots. Groups of dots present ventrally, in the posterior half (Figure 639). Large setae dark brown or blackish brown. Seta 9, the longest seta of the sclerite, situated at margin of dorsal stripe, medial to the eye; seta 11 situated anterior to it, thin, dark and short; seta 7 strong, straight, situated near the margin, slightly thinner and much shorter than seta 9; seta 10 situated lateral to the eye, small and light; long seta 12 and similar but slightly shorter seta 14 situated behind the eye; two setae situated behind each other posteriorly near the dorsal stripe: short, light, thin seta 15 and dark seta 16, which is slightly longer and thicker; seta 17 situated more medially,

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* According to Siltala (1905:125—126, Figure 32) the light form and the typical form of H. picicornis var. auratus, which occur in the north, have no row of dots in the posterior part of the frontoclypeus; dots are present in the dark form.

thin, small, situated at the level of the posterior frontal seta. Ventral seta 8 small, dark, situated near the margin; seta 18 very small.

Dorsal sclerite of labrum (Figure 638) yellow, smoke brown laterally, with light spots at the base of the setae; 2 semicircular brown spots near the posterior margin; posterior-angle sclerites with reddish brown stripes. Setae 1 light, recumbent on the median indentation; setae 4 spinelike,
443 brownish, situated posterior to the median indentation; setae 2 and 5 situated laterally, at a distance from the anterior margin, thin, light brown; seta 6 similar, situated posterior to the median seta; seta 3 dark brown, at the margin, longer and thicker than the others. Narrow membranous margin of labrum with sparse white hairs anteriorly and laterally.

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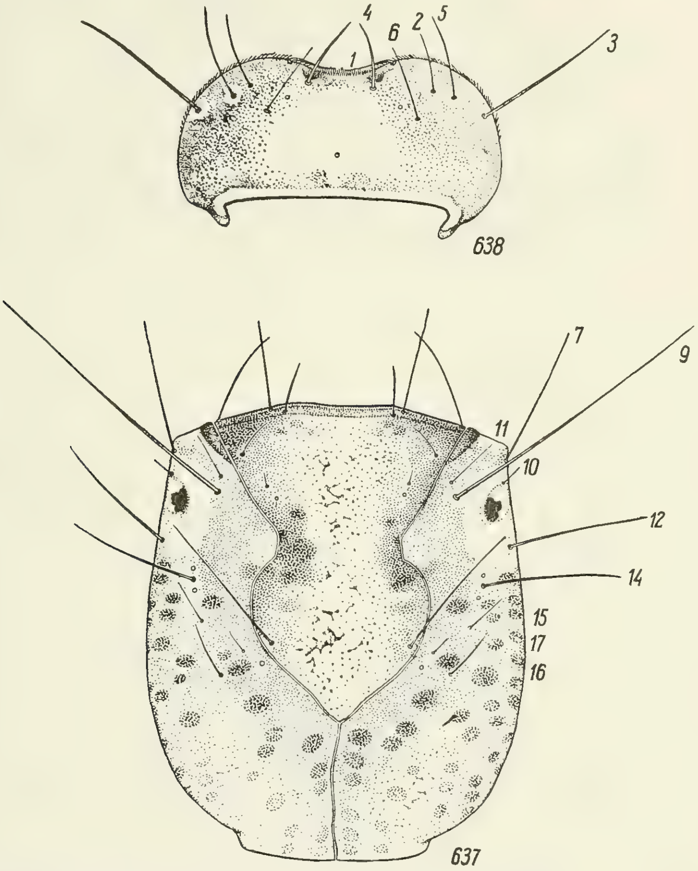
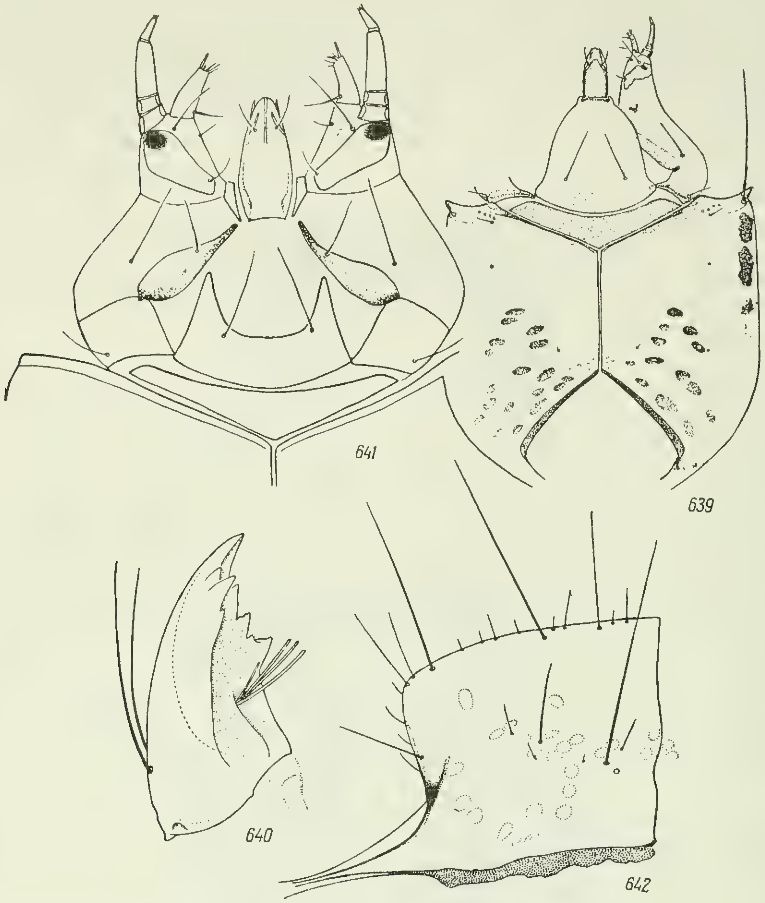


FIGURES 637 and 638. Holocentropus picicornis Steph.: 637 — head, dorsal; 638 — labrum.

Upper blade of left mandible (Figure 640) with 3 teeth, middle tooth projecting basal tooth small; lower blade with 3 large teeth and a small denticle near the basal denticle; median depression with a tuft of several long, light setae. Upper blade of right mandible with one tooth; lower blade with 2 large teeth and a small basal tooth. Outer setae light, long, situated close together dorsoventrally in the basal quarter.



FIGURES 639–642. Holocentropus picicornis Steph.:

639 – head, ventral; 640 – mandible, dorsal; 641 – maxillolabium; 642 – pronotum.

Maxillolabium (Figure 641): submentum brown, with lateral processes at the anterior margin; setae strong, relatively long, reddish brown; both setae of stipes dark; distal seta situated on a sclerite; second seta situated on a membrane, larger than the other setae; maxillary palpifer blackish at
444 the base, with a strong apical seta and a dark reddish brown spot; basal seta small and light; palps and galea brownish; setae and rods of galea light, transparent; mentum reddish brown; setae of ventral sclerites pale, thin, relatively long; labial palps small.

Pronotum (Figure 642) yellow, with reddish brown posterior margin; stripe of posterior-angle process and spot at lateral margin reddish brown; anterior part of lateral margin narrow, reddish brown, not reaching angle of sclerite. Punctate pattern pale; 2 dots near the median suture in the posterior half; a wide bracket-shaped row of dots laterally; a group of 2 or 3 dots and 2 dots further anteriorly, medially to this row.

Anterior-angle seta short, dark brown, strong; a thin seta near it; lateral margin with 2 light setae posteriorly, posterior seta very small. Anterior margin with 3 long setae, the longest of them situated near the anterior-angle seta; second seta similar, situated in the middle of each half of the segment; third seta situated at a distance from the median suture and much shorter; anterior margin also with 9—11 short or very short setae. Surface of sclerite with long, relatively thick medioanal seta in the group of dots; a short, thin seta anterior to this seta, a small setuliform seta laterally; a moderately long seta and 2 short thin setae among the dots of the bracket-shaped row of dots; a large, blackish brown seta near the dark spot at the lateral margin; 2 small, thin setae anterior to it, one seta posterior to it.

Propleuron mainly yellow; pleural suture dark brown. Episternum brown basally, with 3 large, dark spots, with a narrow brown stripe apically, like the epimeron; trochantin brownish, with a dark, thin basal seta and 2 light setules on the membranous apex; epimeral seta dark, situated near the middle of the pleural suture; ventral process of epimeron blunt.

Meso- and metathorax broader and longer than prothorax; dorsum with a pattern of 2 longitudinal, thin, white, narrow stripes with a transverse median branch posteriorly; white dashes and dots between the stripes. Anterior-margin setae small, shorter on metanotum than on mesonotum; anterior-angle and medioanal setae relatively long, dark, longer than setae of pronotum and seta 9 of head; intermediate and lateral setae small, thin, light; intermediate seta slightly shorter than lateral seta.

Mesopleuron slightly broader than metapleuron; both sclerites yellow, smoke brown in some places, with a narrow blackish brown stripe on the pleural suture and a broad, dark border at the distal margin; both setae small, brownish; one of them situated near margin of epimeron, the second on the ridge of the anterior margin of the episternum, near the articular process.

Legs light yellow, with reddish brown apical margin of the segments; a few large, smoke brown or blackish, large spots near basal margin of coxae and on dorsal side of femur and tibia.

445 Posterodorsal seta of fore coxa thin, one of the longest setae of the segment; anterior basodorsal seta shorter, thin, straight and strong (Figure 643); the primary seta of the 3 strong setae situated near the anterior margin of the distodorsal indentation, longer than the other two; 6 or 7 small setae on the anterior surface; posterior surface with 4 setae; 2 basal setae are thicker than the others; 6 secondary setae ventrally; one of them longer and thicker than the others; distoventral primary setae strong, straight; posterior distoventral seta more than twice as long as anterior seta.

Setae of trochanter numerous; posterior seta strong, long; apical and subapical ventral setae longer than the others.

Distodorsal seta of femur longer than the others; basodorsal seta thin and long; a longitudinal, middle group of thin setae on the anterior surface of the femur, and a row of similar setae near the dorsal margin; a thick, spinelike seta (anterior primary seta) situated apically; small, thin and sparse setae posteriorly; posterior primary seta situated apically, close to the ventral setae, which are of different size, arranged in a regular row, 12–16 in number; primary setae longer than the others.

(444)

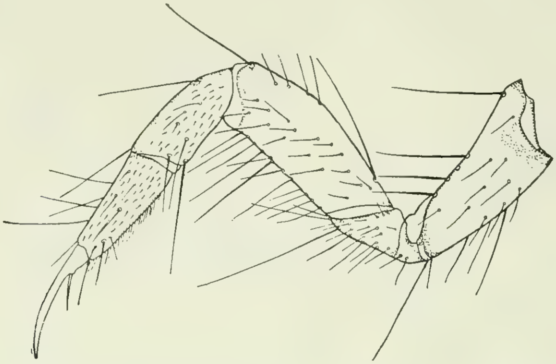
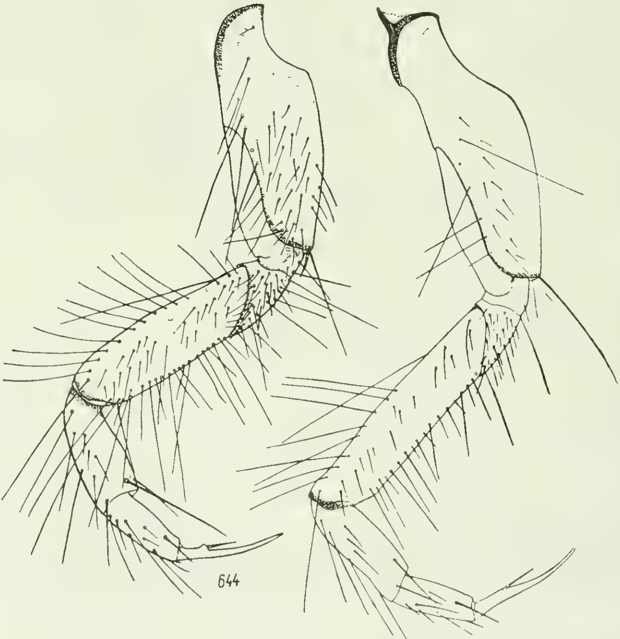


FIGURE 643. Holocentropus picicornis Steph. Right foreleg, anterior



FIGURES 644 and 645. Holocentropus picicornis Steph.: 644 – right midleg, anterior; 645 – right hind leg, anterior.

Tibia anteriorly and ventrally with a cover of small spinules; a distal thin strong, long seta and 3 thin setae dorsally; posterior surface with 2 thin secondary setae; anterior surface with 4 setae; one of them larger and closer to the ventral setae; anterior seta spinelike, dark brown; posterior seta thin; both distoventral setae spinelike; anterior distoventral seta short, posterior distoventral seta long, blackish brown, not quite reaching apex of tarsus.

Spinules of tarsus as on tibia; tarsus ventrally with a comb of golden yellow, thin, small spinules; distal margin anteriorly with a deep indentation
446 and a crown of simple and feathered chetoids; 5 thin dorsal setae, of which the subapical seta is darker and thicker than the others; 3 or 4 thin setae anteriorly and posteriorly; both distoventral primary setae short and thick.

Claw thin, long; seta straight and light.

Coxa of midlegs (Figure 644) with 11 or 12 setae anteriorly, at the dorsodistal notch; hind coxa (Figure 645) anterodorsally with 6 setae; a thin seta basal to this row on midlegs and hind legs; a similar, thicker seta situated at the end of row, further ventrally; secondary setae of anterior surface of mid-coxa more numerous than on hind coxa, covering the whole surface except a small, dorsal stripe; ventral surface of mid-coxa with 4 short setae; distoventral primary anterior seta of both legs strong, long; posterior seta strong but thinner. Trochanter with numerous setae; among them 3 longer ventral setae (one basal and 2 subapical setae).

Mid-femur with slightly convex dorsal margin, resembling the fore femur more than the hind femur; hind femur straight, rodlike, dorsal side of femur without secondary setae; basodorsal primary seta of both legs situated near the base, long, thin; distodorsal seta displaced posteriorly, much shorter; a row of thin secondary setae anteriorly near the dorsal margin; they are more numerous on the midlegs than on the hind legs; a longitudinal row of short setae on the anterior surface at the end of which is a long, strong, anterior primary seta; posterior surface of femur with small, sparse, thin setae; posterior primary seta situated distally; ventral side with a row of setae; this row consists of 17—20 setae on the midlegs and of 16—17 setae on the hind legs.

Tibia and tarsus of midlegs and hind legs with short, setuliform spinules covering the segments on all sides. Primary dorsal setae of tibia darker near the apex and thicker than the more basal secondary setae; anterior and posterior surface secondary setae few in number, thin; a dark spinelike seta among the anterior setae; anterior primary seta spinelike, thick; posterior seta thin and small; both distoventral setae form thick, massive spines, which are of the same length on the hind legs; the anterior seta is longer than the tarsus on the midlegs.

Tarsus slightly shorter than tibia; distodorsal margin crenulate, with rounded processes, with 5—7 transparent spinules and flat pectinate-feathered spinules. Distodorsal seta of tarsus thin, short, recumbent on the claw; second primary dorsal seta and all secondary seta thin, relatively large; distoventral primary setae spinelike and light, thinly feathered; anterior seta situated subapically; posterior seta situated further basally.

Claw thin, long, longer than tarsus, slightly curved in the distal part; its seta transparent, straight; microscopic spinules near the seta, at a distance from the basal margin.

Abdomen long, uniformly broad in its greater part; segment 1 shorter and narrower than the following segments; segments 7 and 8 tapering posteriorly. All dorsal setae of segment 1 small; anterior-angle seta on segments 2—8 large but shorter than on meso- and metathorax; this seta becomes longer, darker and thicker on the posterior segments and is displaced to the posterior half of the segment. Medioanal seta on segments 4—8 also long, thin, shorter than the anterior-angle seta, but this difference disappears on the posterior segments. Lateral setae brownish, long; segment 1 with 2 primary setae; numerous secondary setae present from segment 2 onward at the sides in addition the primary setae; segment 2 and partly segment 3 with fewer secondary setae than the following segments. One of the ventral setae of each segment long and thin, displaced toward the lateral setae on segment 1.

Small dorsal setae of segment 9 grayish brown; a small indentation on the lateral margin; sclerite with a long, dark, medioanal seta and a small, dark, intermediate seta; a short, lateral seta on the lateral membrane; anterior-angle seta small, little marked. Lateral seta of segment dark, strong and long; medioventral seta small and thin; intermediate and lateral setae situated close together, behind each other, long and thick; secondary ventral setae absent.

Anal legs thin and long. Posterior quarter of section "a" with an indistinct transverse fold; stripe on dorsal surface without setae; a broad, longitudinal space covered with thin setae on the outer side near the basal margin. A row of setae, which are longer than the outer setae in the middle; this row does not reach the basal margin and is curved ventrally in the distal part; secondary setae present only distally on the ventral side.

Section "b" shorter and narrower than section "a"; its sclerite light yellow; dorsal side with large, dark dots; distal margin with a small, dorsal process and a large, rounded, lateral process; both processes smoke brown;
447 articular rods thin, reddish brown, X-shaped, with long dark setae at the base. Narrow punctate dorsal stripe of sclerite without setae; other surface of sclerite with the following setae: 2 thick, long outer setae in the basal part; 2 similar thick setae and a thin long seta in the middle; 2 short, light, thin setae of different length in the distal part; a row of 8 or 9 dark long setae on the outer side; in the distal part, this row does not reach the basal margin; membrane near the basoventral angle, with a long and thick seta directed to the claw; parts of outer surface of sclerite also with several thin, small setae. Sclerite "c" rounded, small, smoke brown.

448 Claw (Figure 646) with a few small spinules ventrally; spinules in the subapical band longer, especially dorsally, where there are two straight, large, transparent spinules situated behind each other; surface of claw with microscopic spinules. Basal part with the large dorsal seta 1; the thin, similar, long seta 5 on the outer side; and the dark strong seta 3 near it; basal membrane with the small seta 4; the short seta 2 situated dorsally near the base of the distal part; the long, dark seta 6 situated on the outer side; the straight, thin seta 8 situated ventrally near the base of the membranous, transverse stripe; seta 7 absent.

**Pupa.** Length 7—10 mm. Antennae long, almost reaching end of body. Clypeus short, with a long median seta, a long intermediate seta and a short lateral seta. Labrum broad, with rounded anterior angles; a small pointed process in the middle of the anterior margin; 2 of the 6 setae of the labrum are long and 4 short. Mandibles sickle-shaped, blunt, less strongly curved than in Plectrocnemia; outer setae short. Wing sheaths pointed, reaching abdominal segments 4–5; natatorial setae of tarsi of forelegs sparse, those of midlegs dense; those of hind legs well developed. Plates of holding apparatus brown, present on segments 3–8 (Figure 647); number of spinules as follows: III:5; IV:4–6; V:4–5 + 6–8; VI:4–6; VII:5; VIII:5. Gills consisting of 2 filaments on segments 2–7. Anal lobes short, with numerous black setae (Figure 648).

Pupae lying in a case of loose tissue covered with detritus or fragments of plants; membrane at end of case with coarse-meshed filtering sieves (Figure 649).

(447)

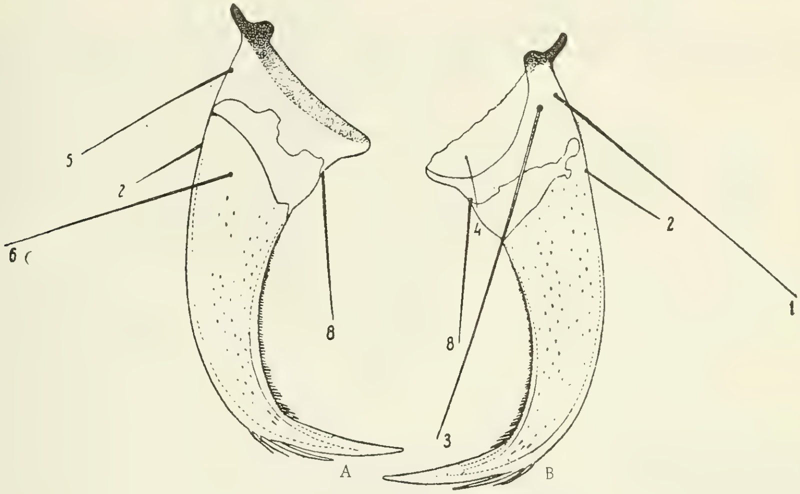
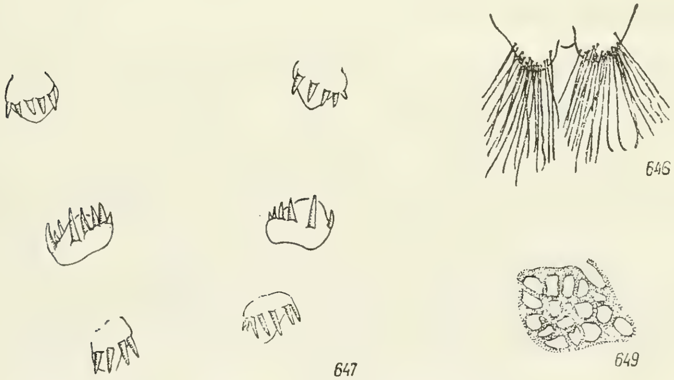


FIGURE 646. Holocentropus picicornis Steph. Claw of anal leg, outer view (A), inner view (B)



FIGURES 647–649. Holocentropus picicornis Steph. Pupa:

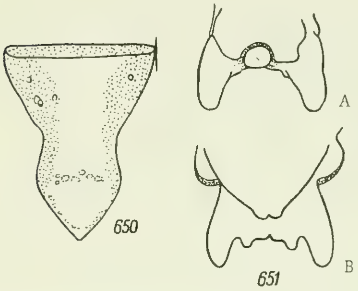
647 – plates of holding apparatus of segments 5 and 6; 648 – anal appendages; 649 – opening in membrane of case (648 and 649 – after Thienemann).

Mode of life and habitats. Small, stagnant water bodies thickly overgrown with plants; also in water bodies with a slow current, among vegetation.

Distribution. Northern, western, central and southern regions of the European USSR (var. danubicus Mart. occur in the southern region), Siberia, Kamchatka. In addition, northern and Central Europe, Mongolia.

### 2. **Holocentropus stagnalis** Albarda

Siltala, 1905:128–129, Figure 33. — Ulmer, 1909:231,-297. — Lestage, 1921:501–502. — Lepneva, 1940:202.



FIGURES 650 and 651. Holocentropus stagnalis Alb. (after Siltala):

650 – frontoclypeus; 651 – end of body of pupa, ventral: male pupa (A), female pupa (B).

**Full-grown larva.** Closely resembling larva of H. picicornis, differing in pattern of frontoclypeus (Figure 650). Dark lateral stripes broad anteriorly; light median area near anterior margin slightly dark; a transverse row of distinct dark dots posteriorly; posterior angle of sclerite also darker than the other parts. The 3 teeth on lower blade of right mandible of the same size, or middle tooth smaller than the others.

**Pupa.** Length 6.5–8.0 mm. Anal lobes longer and narrower than in H. picicornis (Figure 651), rounded at the end, diverging laterally; penis sheath slightly longer and narrower than in H. picicornis. Case made of loose tissue covered with plant fragments, sand grains and silt.

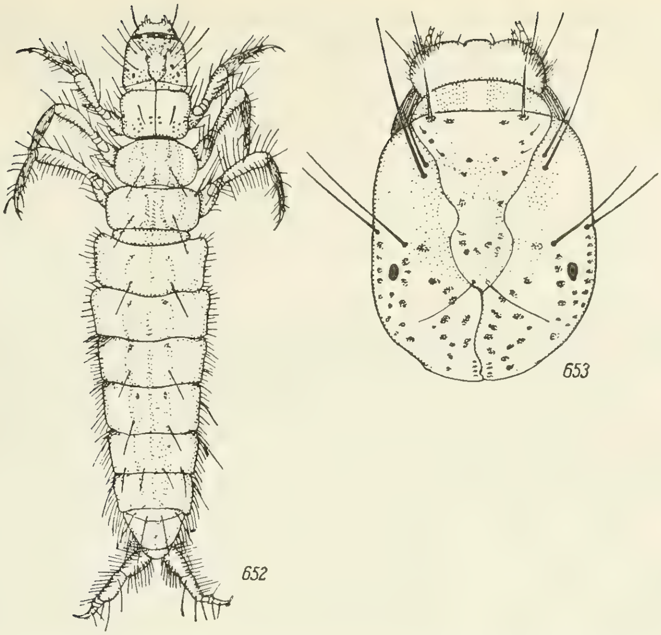
Mode of life and habitats. Stagnant water, among plants and algae.

Distribution. West of the European USSR, the Caucasus, Western Siberia. In addition, Europe.

### 3. **Holocentropus dubius** Rambur

Siltala, 1903:3–7, Figure 1. — Ulmer, 1909:230, 296. — Lestage, 1921: 496–502, Figures 162, a, e, j; 164. — Lepneva, 1940:192, 205, Figure 145. — Hickin, 1943:19–21, Figures 1–9.

**Full-grown larva.** Length 12–14 mm (Figure 652). Frontoclypeus slightly dark anteriorly, darker on the sides of the posterior part and near the bifurcation of the frontal sutures; a curved row of brown dots anteriorly on a dark background; sclerite lighter, lateral to this row; 2 large dots near the middle frontal setae; a transverse row of dark dots in the posterior
449 part. Light spots on the sides of the sclerite, near the curvature of the frontal sutures; dorsal stripes extending from anterior margin to bifurcation of frontal sutures; a light stripe lateral to the coronal suture; this stripe with longitudinal rows of large dots; similar rows of dots present instead of lateral stripes (Figure 653); sides with groups of dots ventroposteriorly. Setae as in H. picicornis.



FIGURES 652 and 653. Holocentropus dubius Ramb. (after Hickin):
652 – larva, dorsal; 653 – head, dorsal.

Labrum* as in H. picicornis. Upper blade of left mandible with 3 teeth; 2 of them small; middle tooth very long; the basal of the 3 teeth of the lower blade large, tuberculate anteriorly; penicillus in the median depression consisting of several light, long, thick hairs. Upper blade of right mandible with a large tooth and a small, basal denticle; lower blade with 3 tuberculate teeth. Outer setae of mandibles situated close together, light and long. Maxillolabium as in H. picicornis.

Pronotum with indistinct dots; setae of thorax, legs, abdomen and anal legs as in H. picicornis.

**Pupa.** Length 7.0–7.5 mm. Antennae of male pupae reaching abdominal segment 8, those of female pupae segments 5–6. Labrum with rounded anterior margin. Mandibles curved, crossed, with blunt ends.

Wing sheaths reaching abdominal segments 5–6; natatorial setae present on fore and mid-tarsi (hind tarsi without setae); mid-tarsi and mid-tibiae of female pupae broad. Presegmental plates present on segments 3–8, postsegmental plates on segment 5; number of spinules as follows: III:5–7; IV:5; V:4–6 + 8–12; VI:5–7; VII:3–6; VIII:2–4. Gills present on segments 2–7; gills of segment 2 with only a dorsal filament; gills of segments 3–7 with a dorsal and a ventral filament. Lobes at end of abdomen rounded, with numerous setae; ventral process of abdominal segment 8 short, blunt.

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* Hickin (1943:19, Figure 4) showed hairs in the anterior angles of the dorsal surface of the labrum in his drawing; these hairs are actually situated on the ventral surface.

450 Pupal case 9—11 mm long, shapeless, made of loose tissue with a covering of plant fragments; pupa lying in a cocoon of light loose tissue.

Mode of life and habitats. Plant thickets in small stagnant water bodies.

Distribution. Western, northwestern and central region of the European USSR. In addition, Europe.

## 4. Genus Cyrnus Stephens

**Full-grown larva.** Length 11—14 mm. Integument delicate, almost transparent; sclerites light yellow, with weakly shaded and distinct punctate pattern. Dorsal stripes of head short, narrow or absent. Abdomen with secondary lateral setae not only on segments 2—8 but also on segments 1 and 9; secondary ventral setae present on segments 8 and 9. Anal legs with numerous long setae; claw ventrally with better marked spinules than in the preceding genera, with 4 small, light, subapical denticles.

**Pupa.** Length 6—7 mm. Antennae long, reaching segments 7—8 or end of abdomen. Lateral seta of anteclypeus less short than in the preceding genera. Mandibles sickle-shaped, blunt. Tibiae and tarsi of midlegs broad, natatorial setae present on fore and mid-tarsi. Plates of holding apparatus present on abdominal segments 3—8; gills present on segments 2—7 or 2—6. Anal lobes broad, rounded, with numerous dark setae.

Case 9.0—12.5 mm long, with loose walls covered with plant fragments, rarely with fine sand grains. Pupa lying in a grayish sheath.

Mode of life and habitats. Predacious; building capturing funnels. Living in slowly running and stagnant water, on the bottom or among vegetation.

Distribution. European USSR, the Caucasus, in Western and Eastern Siberia (rare). In addition, Europe, Iran.

### Key to Species

Full-grown larva

1 (2). Head dorsally with a distinct characteristic pattern (Figure 655); punctate pattern of pronotum indistinct . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **1. C. flavidus** McL. (p. 511)
2 (1). Pattern of head different; dots on pronotum distinct.
3 (4). Head with dots and with distinct dark dorsal stripes lateral to the frontal sutures . . . . . . . . . . . . **2. C. trimaculatus** Cart. (p. 517)
4 (3). Head only with a punctate pattern, without stripes . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **3. C. insolutus** McL. (p. 518)

Pupa

1 (4). Gills present on abdominal segments 2—7.
2 (3). Antennae moniliform in the basal part . . . **1. C. flavidus** McL. (p. 511)

3 (2). Antennae filiform in the basal part . . . . 3. **C. insolutus** McL. (p. 518)
4 (1). Gills present on abdominal segments 1–6 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **C. trimaculatus** Curt. (p. 517)

### 1. **Cyrnus flavidus** McLachlan

Siltala, 1903c:7–10, Figure 2; 1905:132–134. — Ulmer, 1909:229, 296, Figure 354. — Lestage, 1921:503–509, Figures 167–170. — Lepneva, 1940: 201, 205, Figures 152, 6. — MacDonald, 1950:22–24, Figures 5–8.

**Full-grown larva.** Length 14–16 mm. Anal legs extended posteriorly (Figure 654). Head (Figure 655) light-yellowish brown, with chestnut brown pattern; eyes situated on a white background; margin of occipital foramen narrow, reddish brown. Frontoclypeus mainly dark; a light area in the middle and a curved row of dark dots in the posterior part; less distinct dots anterior to the light area form an irregular anterior arc; posterior angle of sclerite light; 3 indistinct large dots and a small dot laterally near the anterior margin. A short median seta and a long intermediate seta near the dots; lateral anterior-margin seta curved and light. Anterior seta of the 3 frontal setae short, thin, situated near the angle; middle seta similar; posterior seta long and dark. Clypangulus narrow, dark brown; antennae situated near the anterior margin, together with 3 setae, middle seta much larger than the others. Indistinct chestnut brown dorsal stripes, which converge lateral to the frontal sutures, near the bifurcation; area near 452 curvature of frontal sutures light; large and small dots in the posterior part along the dorsal stripes, lateral to the coronal suture and at the place of the lateral stripes. Ventral side of head light, with indistinct dots near occipital margin. Seta 9 is the longest seta of the head; seta 11 situated at a distance from it, short, dark; seta 7 situated near margin, much shorter than seta 9; seta 10 small and light; dark long seta 12 situated laterally, posterior to the eye; thin, short seta 13 near it, slightly more dorsally; large seta 14 situated near the dorsal stripe; a pit and setae 15 and 16 situated posterior to it; they are short and thin but distinct; similar seta 17 situated near the suture near the posterior frontal seta. Short seta 8 situated ventrally, at the anterior margin; seta 18 small and setuliform.

Labrum with shallow median depression covered with straight, reddish yellow, short, fine spinules; anterior angles rounded; dorsal sclerite brownish; posterior-angle sclerites reddish brown; membranous anterior margin narrow, with thin light hairs; seta 1 light, recumbent on the median depression; seta 4 situated lateral to the depression, dark and strong; setae 2 and 5 thin, dark, situated near the anterior margin; seta 6 situated posterior to them more medially; seta 3 situated laterally, near the margin, darker, longer and thicker than the others.

Left mandible with 3 teeth on the upper blade; middle tooth projecting and large; lower blade with 3 short, blunt teeth; median depression with 4 straight, light, strong, feathered chetoids in the penicillus. Upper blade of right mandible with 2 strong, projecting teeth; lower blade with a large tooth and 2 small teeth, which are fused. Outer setae of mandibles light and long.

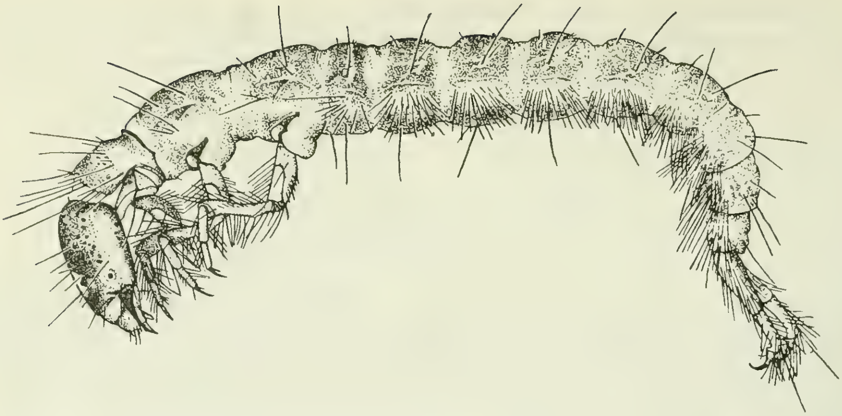


FIGURE 654. Cyrnus flavidus McL. Full-grown larva, lateral

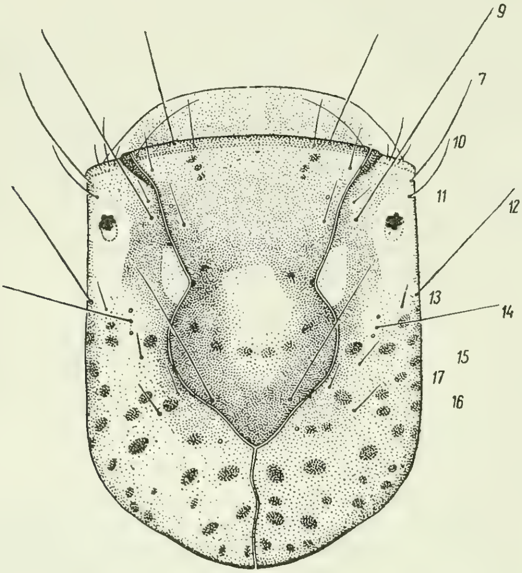


FIGURE 655. Cyrnus flavidus McL. Head, dorsal

Sclerites of maxillolabium mainly light yellow. Gula as in the preceding genera, short, broadly triangular; submentum short; anterior processes relatively large; setae golden brown; cardo ash-gray-yellow; seta at base dark brown; sclerites of stipes indistinct, with a narrow, brown stripe at the median margin; both setae thin and dark, situated on a membrane; palpifer brownish yellow, with reddish brown spots on the angles of the median margin; distal seta situated on a membrane, thin, brown and relatively long; palps and labium with brownish yellow sclerites. Submentum brownish yellow; setae of ventral sclerites light, little marked; palps very small, adpressed to the labium.

Pronotum chestnut brown; posterior margin narrow, pinkish brown; dark spot at lateral margin small; stripe at posteroventral process brownish. Posterior part of sclerite with 2 large dots; 3 or 4 smaller dots lateral to these dots; a group of large dots in the middle of each half; a separate large dot near the anterior angle. Anterior-margin setae less numerous than in the preceding genera; 3 brown, long setae and 7—10 short and small setae near the anterior margin in middle and laterally; a dark moderately long seta on the outer side; anterior-angle seta dark brown, shorter and thicker than the large anterior-margin setae; several small, thin setae in the corner at the margin; a long seta and 3 small thin setae near the median suture; a long seta, 3 dark, short setae and 9 or 10 small setae in the middle; a long seta and 2 small setae at the margin in the lateral part.

Sclerite of propleuron yellow, with a large dark dot and 2 small dots on the episternum; pleural suture narrow, reddish brown; hornlike process smoke brown, with a narrow membranous sucker-shaped process and 2 setules at the end; seta at base of process thin, yellow, relatively large; seta of epimeron similar, situated in the basal part, near the pleural suture.

Metathorax slightly larger than mesothorax; dorsum of segments with a delicate white pattern consisting of a longitudinal and transverse stripe on each side and of small dashes and dots. Anterior-margin seta well marked, slightly longer on mesonotum than on metanotum; dark brown anterior-angle seta long; secondary anterior-angle seta situated anterior to it, dark, similar to the anterior-margin seta and well marked; medioanal surface seta slightly shorter than anterior-angle seta; intermediate seta small; lateral seta brownish and long. Pleural sclerites of both segments light yellow, with smoke brown spots at base and apex; pleural suture dark brown, narrow and margin of episternum broad; episternal seta near suture small; epimeral seta slightly longer, situated distally at the margin.

Legs of almost the same length; forelegs brownish, darker, slightly shorter and more massive than the others. Distodorsal indentation of coxa deep; both segments of the trochanter completely sclerotized; tibiae and tarsi with small covering spinules.

Fore coxa with a light brown, moderately long basal seta anterodorsally; 3 spinelike setae further distally; middle seta of this group long; posterior
453 primary dorsal seta long, reddish brown; 2 thin secondary setae situated further distally; anterior surface of coxa with short, strong, sparse setae including 2 spinelike setae, a small apical seta and a larger subapical seta; similar, strong, short setae ventrally; several spinelike setae closer to the posterior surface; among them 3 large dark setae.

First segment of trochanter with 3 light thin setae; second segment with numerous setae; 2 ventral subapical setae longer and thicker than the others; subdorsal anterior seta situated at the distal margin short, thick and dark brown; posterior seta relatively long and thin.

Femur with convex, dorsal margin; its apical part higher than basal part; basodorsal seta straight and thin; distodorsal seta similar, long, golden yellow; an anterior curved row of thin, sparse setae subdorsally; anterior surface with short, sparse setae, several small, spinelike setae and 2 longer dark brown setae; sparse small setae posteriorly, in the middle; ventral side with a spinelike, thin, posterior primary seta near the apex. Ventral side with a row of 12—14 setae, basal seta strong and spinelike; 2 of the middle setae longer than the others.

Tibia short, almost as long as tarsus, slightly curved in the basal part, its apex higher than the base. Dorsal side with 2 setae; a thin projecting basal seta and a golden brown apical seta directed to the tarsus; subdorsal region with a row of light, long, thin setae posteriorly; 2 setae near the ventral margin apically and subapically (subapical seta?); one of them is the primary posterior seta; 3 massive, thick setae anteriorly in the middle; one of them thicker than the others (primary anterior seta?); dorsal side with several short, strong, thin setae; 2 primary spinelike setae distally on the ventral side: an anterior, short seta and a posterior, dark brown, thick seta.

Tarsus tapering apically; light spinules forming a comb near the ventral margin; dorsal side with a longitudinal row of 6 thin, moderately long, light setae; sides of the claw with a dorsal thin seta; primary anterior seta light brown, spinelike, thick, situated in about the middle of the segment; a row of 3 small, spinelike setae situated behind each other further basally; several small, short setae further dorsally; posterior seta situated subapically near the dorsal margin, dark brown and spinelike, strong and pointed; there are several subdorsal thin, posterior setae; a group of 7 flat, light pectinate spinules, distally in the anterior part.

Claw long and thin, slightly curved; seta straight, light, with thin small spinules at the base.

Midlegs and hind legs light; femora and tibiae slightly darker, brownish dorsally; femora with coarse, light spots; hind legs narrower than midlegs.

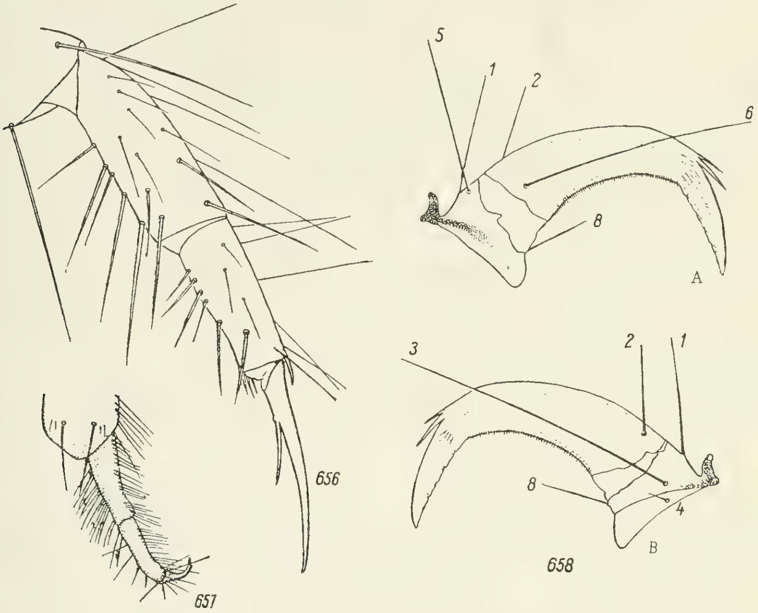
Coxae with indistinct small dots at the base; midlegs with 12–14 dorsal setae near the anterior margin; hind legs with 9 setae, which are lighter and less thick; primary seta of posterodorsal margin thin and long; 2 secondary, widely separated, thin, light setae further distally. Anterior and posterior surface with short, sparse setae on the ventral side; anterior surface with strong setae in the middle; subapical seta thick and spinelike. Anterior distoventral seta moderately long; posterior seta of midlegs less long; that of hind legs about half as long.

Boundary between 1st and 2nd segments of trochanter distinct; 1st segment with 6 small, thin setae ventrally; 2nd segment with numerous setae, 3 or 4 of which are longer.

Femur of midlegs with a slightly convex dorsal surface in the apical part; hind femur straight and rodlike; basodorsal seta long and thin; apicodorsal seta darker and shorter; a subdorsal row of thin, long setae including a dark, long anterior primary seta anteriorly; anterior surface with short setae; setae on hind femur sparser than on mid-femur; similar setae in the middle of the posterior surface; a strong brown, primary posterior seta subventrally near the apex; a row of straight, smooth setae of different length ventrally; midlegs with 18 or 19 setae, hind legs with 17 or 18 setae in this row.

Tibiae (Figure 656) almost as long as tarsi; dorsal stripe bordered with thin setae; anteriorly and posteriorly; anterior row consisting of 4 or 5 setae, posterior row of 6 or 7 setae; subapical primary distodorsal seta longer and slightly darker and thicker than the others; primary anterior seta spinelike, situated subapically; a row of 4 thick and thin setae further basally, at a distance; posterior primary seta of midlegs (like that on forelegs) light and thin; this seta on hind legs massive, spinelike, dark, resembling the ventral setae but shorter; a thin secondary seta near it;

454 ventral side with 2 massive, long, spinelike distal primary setae; posterior seta especially long; that on hind legs almost as long as the tarsus; midlegs anteriorly with 3 thin, spinelike setae further basally at the ventral margin; hind legs with one such seta; midlegs with 4 (hind legs with 3—5) long, spinelike setae, which are thick or thin and light posteriorly.



FIGURES 656—658. Cyrnus flavidus McL.:

656 — left midleg, distal pair, anterior; 657 — abdominal segment 9 and anal leg, dorsal (after McDonald); 658 — claw of anal leg, outer view (A), inner view (B).

Tarsus narrower than tibia. Dorsally, near the anterior margin are 6—7 thin, relatively long setae on the midlegs and 7 or 8 on the hind legs; 2 thin subdorsal setae posteriorly, which are longer on the hind legs than on the midlegs; a short, thick, blunt, spinelike, light seta distodorsally; anterior surface of midlegs with a light brown, feathered, short, primary anterior seta at a marked distance from the apex (this seta is situated closer to the apex on the hind legs); midlegs with 3 thin setae further basally. Posterior primary seta like the anterior seta situated subventrally in the distal part; midlegs with 5, hind legs with 4 spinelike setae, further basally at the ventral margin; 7 flat, pectinate, light spines arranged in a fan anteriorly, near the apex; one of the spinules on the ventral side thicker.

Claws slightly longer than on the forelegs, slightly curved at the end; minute spinules near the seta.

Integument of abdomen delicate, almost transparent; dorsum slightly darker than venter, with a pattern of white stripes and spots.

First segment shorter and slightly narrower than following segments; anterior-margin seta light, small; anterior-angle seta slightly larger; median seta of the 3 medioanal setae smaller than the others; lateral seta dark, short and longer than the others; both primary lateral setae situated close together, one behind the other, dark and long; unlike in the other genera, pleural region with several thin and light secondary setae. Median
455 ventral seta moderately long, dark; intermediate seta small and thin; lateral seta situated at a distance from the other two, dark, strong and long.

Small sclerites in posterior part of dorsum of segment 9 grayish, broader than long; medioanal seta dark, thick, long; intermediate seta small; lateral seta short, thin and dark; anterior-angle seta situated laterally in the anterior part, small and dark. Thin secondary setae in the pleural region, dorsoventrally; ventral medioanal seta thick, dark, long; lateral seta larger, strong, situated laterally among the secondary setae.

Anal legs thin and long (Figure 657); section "a" longer than section "b," with a transverse fold in the distal third. Dorsal stripe of section "a" without setae; dense setae form three longitudinal rows at a distance from the basal margin: 2 subdorsal rows lateral to the stripe on the dorsal side of section "a" and lateral to the outer subventral row, which merges in the distal part with the ventral region; several setae distally in the space between upper and lower rows of section "a."

Section "b" narrower than section "a"; sclerite light yellow, with large, indistinct dots and a broad, reddish brown, basal lateral margin; apical margin with a deep indentation, which separates the lateral lobe from the dorsal articular process; latter not X-shaped and divided only at the end; its margins form thick, reddish brown ridges; 2 long, dark brown, dorsodistal setae dorsally near the base of the thick margin; 2 thin, short, subapical setae posterior to them; several setae near them and further basally. A regular row of 7 large setae at the distal margin and at the ventral margin on the outer side; 3 of these setae dark brown, longer and thicker than the others; a long, thin basoventral seta directed to the side of the claw in the basal lower angle near the margin. Dorsal stripe of sclerite without setae except several small setae in the distal part; 7 setae at the inner margin, 5 of which are long and thick, the other 2 short and thin; a group of 6 long, brown setae forming an upper and a lower row, in the basal part, on the outer side.

Sclerite "c" small, rounded, brownish yellow.

Claw (Figure 658) shorter than in Holocentropus; ventral spinules thin, light, well marked; spinules of subapical band small and thin laterally; this belt contains a large, light spine; a similar but smaller spine further basally; 4 light parts giving the impression of 4 denticles distal to this band on the ventral side. Dorsal seta 1 thin, relatively long; long seta 5 situated lateral to it on the outer side; the thick, dark seta 3, which is the longest seta of the claw situated more medially in the basal part; a membrane further basally has small, thin seta 4; ventral seta 8 situated on a sclerite near the basal margin of the membranous transverse stripe; seta 7 absent; dorsal seta 2 short, thin, situated near the distal part of the claw; seta 6 situated on the outside, near the membranous, transverse stripe, thick, dark and long.

**Pupa.** Length 6—6.8 mm. Antennae moniliform, reaching abdominal segments 5—6. A deep lateral fold between anteclypeus and labrum; 2 of the 3 setae of anteclypeus long and one short, but not as short as in Plectrocnemia; 2 long setae of labrum shorter than setae of anteclypeus; other setae small. Mandibles sickle-shaped, blunt; outer setae very short; right mandible situated above the left at rest.

Wing sheaths reaching segments 4—5. First four segments of tarsi of fore and midlegs with natatorial setae.

Gills present on abdominal segments 2—7; gill of segment 2 consisting of one dorsal filament, gills of segments 3—6 of 2 filaments; a dorsal and a ventral; gill of segment 7 consisting of one ventral filament; if a dorsal filament is present it is short.

Plates of holding apparatus present on segments 3—8; small pointed spinules present among the large blunt spinules; number of spinules as follows: III:6—10; IV:5—10; V:5—9 + 7—11; VI:7—10; VII:5—8; VIII:6—8.

End of body with 2 short rounded lobes with numerous strong dark setae. Sheath of outer lobes of male genitalia broad and rounded; penis sheath divided at the end; segment 8 of female pupa with a broad, conical process ventrally.

Pupal case 10—12 mm long; walls of case made of loose tissue covered with plant fragments, sand grains or fragments of shells; pupa lying in a grayish brown cocoon.

Mode of life and habitats. Predacious, building capturing nets; stagnant and slowly running water; on the bottom and in plant thickets.

Distribution. European USSR: Western Siberia. In addition, Europe.

456 2. **Cyrnus trimaculatus** Curtis

Siltala, 1905:129—130, Figure 34. — Ulmer, 1909:229, 296. — Lestage, 1921:504—510, Figures 168—169.

**Full-grown larva.**[*] Length 10—11 mm. Sclerites light yellow, with distinct punctate and shaded pattern. Frontoclypeus mainly yellow; margin of anterior part and middle dark; sclerite with 3 small dots on both sides anteriorly; 1 dot and 2 dots on the stripes posterior to them; posterior part with a transverse curved row of dark, large dots. Short, dark, broad dorsal stripes extending also along the coronal suture lateral to the frontal sutures, beginning in the middle of the sclerite; large dots on the stripes and lateral to them; similar dots present instead of lateral stripes.

Teeth of right mandible blunt; middle tooth of lower blade larger than the others.

Pronotum with distinct dots, slightly darker posteriorly; 2 dots near the median suture; a longitudinal curved row of dots in the middle of each half; anterior angles of sclerite with 2 or 3 dots.

Propleuron with dark dots in the episternal part; hornlike process brownish.

**Pupa.** Length 6—8 mm. Antennae moniliform, reaching abdominal segments 7—8. Fore and mid-tarsi with natatorial setae. Number of spinules on plates of holding apparatus as follows: III:3—7; IV:5—8; V:4—6 + 7—13; VI:7—10; VII:6; VIII:5—6. Gills less numerous than in the other species: gill of segment 2 with one dorsal filament; gill of segment 3 with a dorsal and ventral filament; gills of segment 4—5 sometimes with

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[*] Larva little known.

dorsoventral filaments; only the ventral filament of these gills sometimes present; gill of segment 6 with only a ventral filament, or gill absent; segment 7 without gills.

Lateral lobes at end of body relatively narrow, with strong, dark setae; penis sheath broad and rounded at the end.

Pupal case to 12 mm long; walls loose, with a covering of sand grains and detritus.

Mode of life and habitats. Predacious, building capturing nets; living in lakes and slow rivulets and brooks.

Distribution. The western and central regions and south of the European USSR, the Caucasus. In addition, Europe, Iran.

### 3. **Cyrnus insolutus** McLachlan

Siltala, 1903c:10–11, Figure 3; 1905:131–132, Figure 35. — Ulmer, 1909:230, 296. — Lestage, 1921:504–510, Figures 168–169.

**Full-grown larva.** Length 11 mm. Sclerites yellowish; punctate pattern distinct; membranous parts darker than in C. flavidus, with a pinkish tone. Frontoclypeus mainly slightly dark; its middle light; dots distinct on dark background; curved row of large dots posterior to the sclerite sharply marked. Dorsal surface of head mainly brownish lateral to the frontal sutures or brown only near the sutures; dorsal stripes indistinct; large dots present in their place, along the coronal suture and along the sides. Light spots at the base of setae; sclerites dark ventrally at the sides near the occipital foramen, with large groups of distinct dark dots; gular suture with a narrow, dark margin.

Propleuron with distinct dots; hornlike process dark; pleural sclerites of meso- and metathorax brown. Coxae, femora and tibiae with dark dots.

Sclerite of section "b" of anal legs yellow, with large dots; claw dorsally with 1 or 2 small spines in the region of the subapical band.

**Pupa.** Length 6.0–6.5 mm. Antennae almost reaching end of body. Labrum and mandibles as in C. flavidus. Wing sheaths reaching end of segment 5 or middle of segment 6; natatorial setae present on the tarsi of fore and midlegs. Gills present on segments 2–7; gill of second segment sometimes with a dorsal and a ventral filament; this gill has only a dorsal filament in most specimens; segment 2 without gills in some specimens; segments 3–6 with 2 gill filaments; segment 7 with only a ventral filament or also with a short, dorsal filament. Plates of holding apparatus present on segments 3–8; number of spinules as follows: III:6–12; IV:6–9; V:6–9 + 11–16; VI:8–13; VII:6–8; VIII:5–7.

Anal lobes of male pupae with rounded indentations on the inner side; they are narrower at the end and widely separated in female pupae.

Pupal case 9–13 mm long. Walls of case loose; case covered mainly with fine plant detritus, sometimes also with silt and larger fragments of plants; pupa lying in a gray, thin cocoon.

457 Mode of life and habitats. Stagnant and slowly running water.

Distribution. West of the European USSR. In addition, Europe (rare).

## 5. Genus Neureclipsis McLachlan

**Full-grown larva.** Large, 17–18 mm long. Sclerites yellowish, with distinct punctate pattern; shaded pattern absent; membranous parts also light. Median frontal setae not shorter than posterior frontal setae and almost as long as these; both types of setae much shorter than seta 9. Gula broad, longer than in the preceding genera, wedged deeper into the head capsule; lateral angles of pregula truncate, so that it is pentagonal together with the gula.

Forelegs shorter than midlegs and hind legs; coxae of legs, especially of forelegs, short, broad, massive, with a shallow, distodorsal indentation. Setae of legs mainly strong, many of them short or spinelike; posterior distoventral seta of fore coxa shorter than anterior seta; basodorsal seta of femur almost as long as distodorsal seta. Secondary setae less numerous than in the preceding genera.

Setae of abdominal segments (excluding segment 9), thin, light; secondary lateral setae present in small numbers; segment 9 very short; ventral medioanal setae forming short, black, thick spines situated on small sclerites. Section "a" of anal legs shorter than section "b," almost bare, except for a few mediodistal setae.

**Pupa.** Length 7–10 mm. Lateral seta of anteclypeus longer than the other two. Labrum short, its setae displaced to the anterior margin; 2 of them short and 4 long. Hind tibia with short basal [apical?] spurs of equal length, which are fused at the base. Lateral lobes at end of abdomen in a straight line with the posterior margin; rounded laterally and pointed.

Pupal case to 10–17 mm long; walls loose, covered with fine sand grains, detritus or silt; there are sometimes many cases together.

Mode of life and habitats. Predacious; they build capturing nets, and sometimes occur in large colonies. Large, strong rivers in the plains and small rivulets overgrown with plants; they sometimes occur in the surf area of lakes.

Distribution. European and Asian parts of the USSR. In addition, Europe, North America.

### 1. Neureclipsis bimaculata Linné

Siltala (N. tiguriensis Fabr.), 1903:11–16, Figure 2. — Ulmer (N. tiguriensis Fabr.), 1903:147. — Siltala, 1905:124, Figure 30. — Ulmer, 1909:229, 295–296, Figure 231, a. — Lestage, 1921:481–487, Figure 155. — Lepneva, 1940:204–205, Figure 153. — Brindle, 1960b:244–245, Figures 1–8.

**Full-grown larva.** Length 16–18 mm. Head yellow, with a brownish shade, a whitish shade dorsoventrally; eyes situated on a light area (Figure 659, A). Frontoclypeus with a transverse row of 6 large, dark dots in the posterior part; the two dots next to the lateral dots slightly displaced posteriorly; therefore, the row appears slightly curved laterally. An anteriorly-directed arc of 6 dots anterior to this row in the middle; 3 indistinct dots on both sides near the anterior margin. A row of 6 coarse dark dots lateral to the frontal suture, in the middle of the sclerite; 6 additional smaller dots posterior to this row in the posterior part.

Indistinct dots present on the sides of the head. Anterior margin with a distinct, dark brown stripe ventrally; broad groups of dots lateral to the gular suture near the occipital foramen.

Gula (Figure 659, B) broad; sides of pregula straight, so that the whole sclerite appears pentagonal with concave anterior margin, posteriorly-directed apex and short sides.

(458)

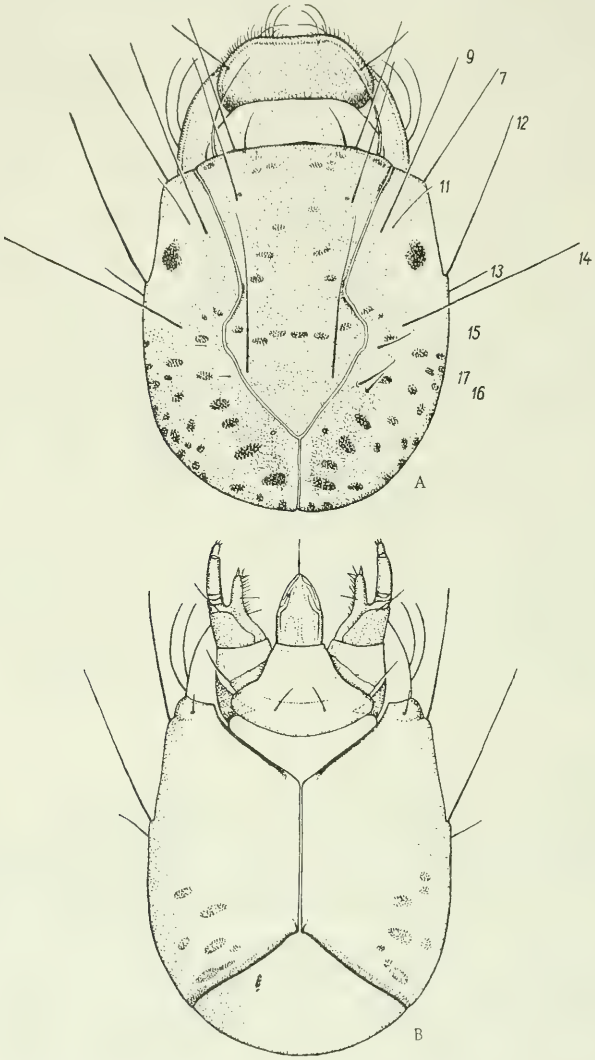
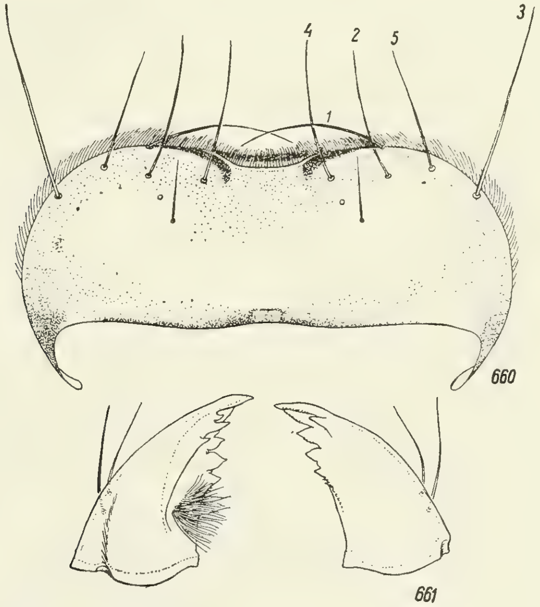


FIGURE 659. Neureclipsis bimaculata L. Head, dorsal (A) and ventral (B)

Lateral seta of the 3 anterior-margin setae of frontoclypeus curved inward, thin; intermediate seta situated at a distance, dark and relatively long; median seta situated nearby, small and light. Anterofrontal seta slightly larger, situated near the anterior angle; mediofrontal seta situated further medially and posteriorly, at the level of the posterior margin of the clypangulus, dark and longer; posterofrontal seta slightly larger, situated posterior to the transverse row of dots, near the margin, relatively shorter than in other genera and markedly smaller than seta 9. Seta 7 situated near base of mandibles, dark and strong; seta 9 situated near the frontal suture, relatively long; seta 11 situated nearby, thin and light brown; seta 10 small
458 and light; setae 12 and 14 long; seta 14 almost as long as seta 9; the small, thin seta 13 situated between them; setae 15, 16 and 17 small and yellowish. Ventral seta 8 setuliform, situated at the anterior margin; seta 18 small, light, situated medial to the group of dots.

Labrum (Figure 660) broad, short; median depression shallow; the setae in it straight and golden brown; light hairs present laterally near the margin. Dorsal sclerite light yellow; narrow, reddish brown posterior margin and posterior-angle sclerites reddish brown. Seta 1 relatively long, light, curved
459 above median depression; setae 2, 4 and 5 thin, similar, forming a row near the anterior margin; surface seta 6 short, light; seta 3 larger than the others, brown, situated laterally near the margin.



FIGURES 660 and 661. Neureclipsis bimaculata L.:

660 – labrum; 661 – mandibles, dorsal.

Mandibles (Figure 661) short. Left mandible with 3 teeth on the upper blade; middle tooth longer than the others; a serration consisting of 6 small, blunt denticles further basally; lower blade with 3 teeth, which are partly serrated; 1 or 2 small denticles between the lateral tooth and the next tooth; several denticles further basally; median brush situated near the base of the depression, forming a tuft of light feathered chetoids. Large, distal denticle of right mandible serrated at the margin; median depression of right mandible marked only distally; upper blade with 2 teeth, lower blade with 3 teeth; teeth partly serrated; basal tooth very small; a row of 8 or 9 microscopic light spinules at its base. Outer setae of mandibles situated near the ventral margin, light, relatively long; basal seta almost straight, second seta slightly curved.

Sclerites of maxillolabium (Figure 659, B) whitish yellow or yellow, darker in some places. Submentum broad, shorter than gula; anterior-angle processes small, thin apically, dark brown; setae strong and dark. Cardo with dark brown margin at the side of the gula; seta at base small, thin. Stipes yellow, with a dark brown stripe; basal seta situated on a membrane near the sclerite dark brown and strong; apical seta light, thin, situated near the margin. Palpifer yellowish white, slightly darker on the outside near the base of the palp; mediodistal seta strong, dark, slightly smaller than seta of stipes; basomedian seta transparent, small and spinelike; galea short. Mentum brown; ventral sclerites small; their setae small and light; palps very small and adpressed to the ligula.

Pronotum yellow; its posterior margin narrow, reddish brown; spot at lateral margin large, blackish brown; ridge on posterolateral process with a narrow, brownish stripe; a white, longitudinal stripe at the point of fusion of the posterior-angle processes ventrally in the middle; this stripe narrow anteriorly and broad posteriorly. Three large dots on the dorsal
460 side along the suture, in about the middle; a curved row of dots and a large dot anterior to them in the middle of each half; 4 dots present near the anterior angle. Setae reddish brown or blackish. Anterior-angle seta moderately long; a small, light seta near it. Anterior margin with 3 long setae, median seta shorter, seta situated near the anterior-angle seta longer than the others; a short, dark seta near the middle seta, 9–10 small thin setae at the margin. A long, dark seta situated slightly anterior to the spot near the lateral margin; a very small, thin seta anterior to it, close to the anterior angle; a spot with 2 small, thin setae posteriorly. Surface of sclerite with 2 large, dark setae which are as long as the anterior-margin setae; 4 small setae near the base of the median seta; 2 setae near the second seta; a short dark seta near the anterior-angle group of dots.

Propleuron (Figure 662) yellow; pleural suture blackish brown; near episternum with 3 large, indistinct dots near the suture; epimeron with a thin, brown seta; seta of trochantin similar, situated near the boundary with the episternum; both setules light, situated on a membrane.

Mesothorax longer than metathorax; dorsum of segments with a delicate white pattern of stripes and spots. Anterior-angle and medioanal setae of dorsum dark, thin, relatively large; anterior-margin seta of mesonotum shorter than angle seta, dark; seta of metanotum small and light brown; secondary anterior-angle seta, intermediate and lateral surface setae small and light.

Pleural sclerites of both segments small, light yellow, much smaller than propleuron, with a narrow, short, pleural suture; epimeron rounded posteriorly; seta situated near the margin of the sclerite light; seta of episternum similar.

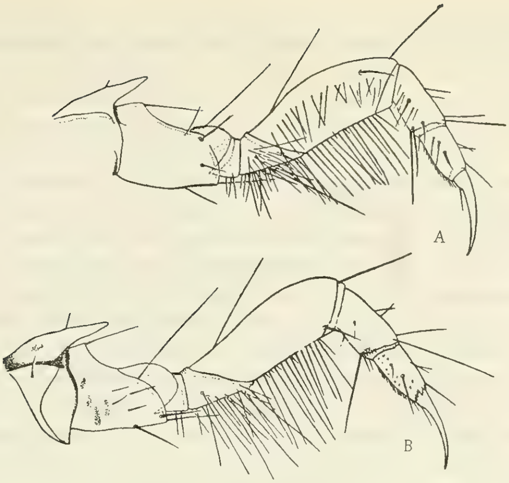


FIGURE 662. Neureclipsis bimaculata L. Propleuron and foreleg: left foreleg, anterior (A), right foreleg, posterior (B)

(461)

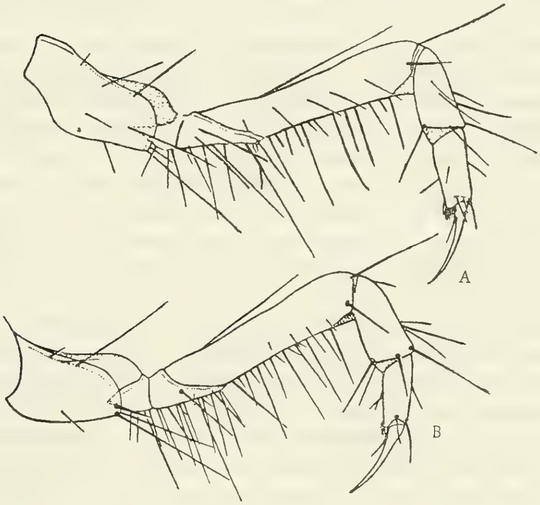


FIGURE 663. Neureclipsis bimaculata L. Hind leg: left leg, anterior (A), right leg, posterior (B)

Sclerites of legs light yellow, with indistinct dark spots in some places; secondary chaetotaxy, particularly that of coxae and femora not as rich as in the preceding genera; forelegs shorter than midlegs and hind legs; ratio of length of legs 91:100:101.

Indistinct dark spots near basal margin of fore coxa (Figure 662) on the posterior surface; distodorsal indentation shallow; secondary setae short, dark brown or blackish brown. Basal primary seta at apex of tubercle thin, relatively long; apicoanterior seta blackish brown, spinelike; margin of indentation also with an additional similar seta; a primary thin, long seta near the posterior margin of the indentation; anterior surface with a short, strong seta in the distal part; second seta situated further basally, together with a similar secondary seta; posterior surface with 3 or 4 short secondary setae; ventral side with one large, strong seta; distoventral setae short, strong; anterior seta longer and thinner than posterior seta.

Setae of trochanter brown or light brown. Basal segment ventrally with 3 short, strong setae; a small, thin seta anteriorly near the suture; an even smaller setule situated dorsally. Posterior surface of 2nd segment with a long, primary posterior seta and several small, thin secondary setae; anterior surface with setae of varying size; ventral side with numerous thick, mainly long setae; primary setae present among them.

Femur short, dorsal margin slightly convex; ventral margin straight; setae, except a few, brown or light brown; basodorsal seta thinner and lighter than distodorsal seta; distal part with a thick, black, anterior primary seta anteriorly and subdorsally; a subdorsal, longitudinal row of 22—25 brown short setae and several very small, thin setae; posterior surface subventrally near the distal margin with a short, strong, dark brown posterior 461
primary seta; a row of 13—15 strong, long setae and several very small, thin anterior and posterior setae ventrally.

Tibia short, slightly broader apically; a short, thin, light seta lateral to the bare dorsal stripe, a brown, strong, relatively long seta distally; posterior surface of segment with 3 thin, soft, light setae; 3 short, spinelike, dark brown setae anteriorly in a longitudinal row; middle seta longer than the other two; 2 or 3 additional small, spinelike, light setae; primary, posterior surface seta spinelike, dark, situated near the ventral setae; anterior distoventral seta half as long as posterior seta, which forms a long, blackish brown spine that is slightly longer than the tarsus. Surface of segment with small spinules on the subventral and ventral side anteriorly and posteriorly.

Tarsus narrower apically; a thin light seta lateral to the bare dorsal stripe in the middle; anterior part with a relatively long, brown subapical (primary?) seta; posterior distodorsal (primary?) seta forming a blunt, short, thick light spine; anterior surface with a light brown, spinelike primary seta in about the middle; 2 thinner, dark brown, secondary setae situated one behind the other further basally to this seta; posterior surface with a light brown, massive, spinelike primary seta basal to which are 3 thin, light, secondary setae; a small comb of short, golden brown spinules curved toward the apex ventrally; spinules of apex transparent, flat, longer ventrally. Sclerite with minute spinules anteriorly and posteriorly.

Claw slightly curved; basoventral seta light, thin; minute spinules further basally.

Mid- and hind coxae moderately long; distodorsal indentation deeper than on the forelegs; secondary setae more numerous; posterodorsal seta thin, brown, longer than on the forelegs; both anterodorsal setae long, strong, longer on the hind legs than on the midlegs; one of them situated distally

near the margin of the indentation; the other near the apex; 2 brownish, thick setae further basally (Figure 663); anterior surface of mid-coxa with several short, dark, spinelike setae; coxa of hind legs anteriorly with a small subdorsal seta and 2 subventral setae, the subapical seta strong, relatively long, almost as long as the distodorsal seta; posterior surface of coxa of midlegs and hind legs with 4 short, spinelike setae; anterior distoventral
462 seta strong, long, posterior seta forming a short, thick spine.

First segment of mid-trochanter with 5 (trochanter of hind legs with 4) long, ventral setae; secondary setae of 2nd segment, especially those of the hind legs, not as numerous as on the forelegs.

Femur long; dorsal margin of mid-femur slightly convex; dorsal margin of hind femur almost straight; basodorsal seta thin, long; distodorsal seta strong, dark, moderately long, displaced posteriorly; anteriorly, near the apex, primary spinelike seta and a longitudinal row of 6 or 7 setae on the midlegs and of 4 or 5 secondary setae on the hind legs; midlegs with 2 2 additional setae distally. A spinelike seta and a thin, subventral seta; posterior, primary seta spinelike; secondary setae of posterior surface of femur. Few, sparse, thin, light; ventral side with a row of 12—14 short, long, and very small, strong, spinelike setae.

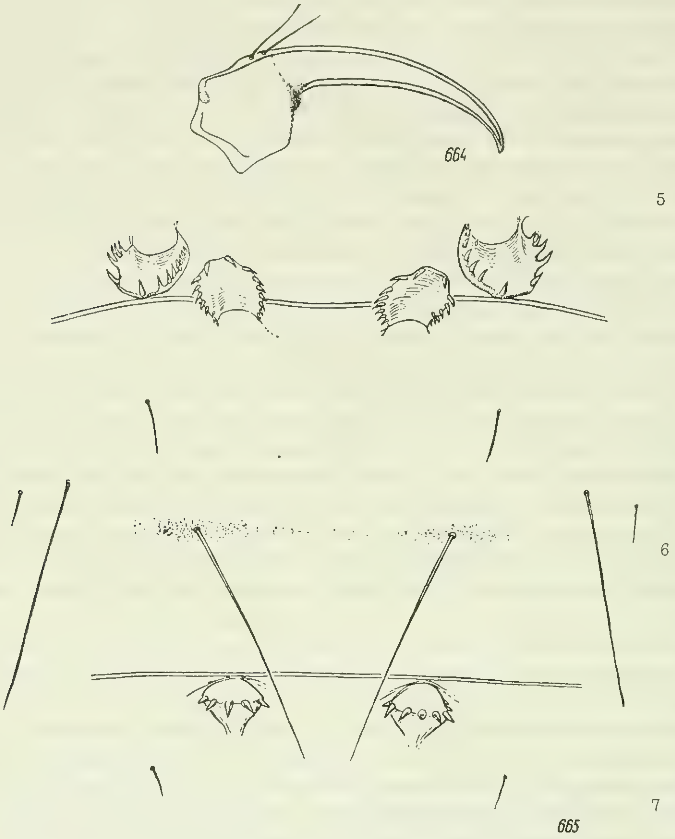
Mid- and hind tibia slightly longer than fore tibia, broader apically, slightly curved. A dark, strong seta, which is slightly displaced posteriorly, similar to that on the femur dorsally, near the apex; 2 thin dorsal setae situated one behind the other further basally, closer to the middle; the basal seta half as long as the other; a strong, spinelike, primary seta anteriorly; mid-tibia with 3 (hind tibia with 2) short, spinelike setae subdorsally; posterior surface with only a primary posterior seta on the hind legs; this seta is thin and situated subapically; it forms an apical massive, dark brown spine on the hind legs; distoventral setae blackish brown, long and spinelike, the posterior seta slightly longer than the anterior one. Small spinules present on tibia and tarsus; these spinules are blunt and short distally, near the margin.

Tarsus slightly longer than on the forelegs, of the same form; ventral comb of spinules absent; a strong, dark brown seta curved to the claw distally and dorsally; a thin, subdorsal, light brown seta near the middle of the segment, anteriorly and posteriorly; anterior seta about half as long as posterior seta; anterior and posterior primary, ventral setae situated subapically; posterior seta situated nearer to the margin; both light brown, spinelike and feathered, a thin, light seta subventrally in the middle of the anterior part; spinules of apical crown long ventrally.

Claw thin, slightly curved, with a light spinelike seta; short spinules basal to the seta.

Abdominal segment 1 smaller than 2; segments 2—7 of about the same width; segment 8 slightly shorter and narrower, segment 9 much smaller. Segment 1 dorsally with a moderately long lateral surface seta; other setae, including anterior-angle seta, short; 2 lateral setae dark, long, situated close together; secondary lateral setae absent; median and a lateroventral seta situated near the anterior margin and larger than the others. Anterior-margin seta on segments 2—6 light and small, dark and long on segments 7—8; dorsal-anterior-angle seta and medioanal seta long, situated in the anterior half on segments 2—6 and in the posterior half on segments 7—8; 16—18 secondary lateral setae of the spurious lateral line light; one or two of them longer than the others on each segment. Medioanal seta on segment 9 long, dark; intermediate and lateral setae short; secondary lateral setae absent; a strong, dark seta situated on a light brown dot laterally; ventral side with 3 setae; 2 of them situated on the sides of the segment, one behind the other; setae dark and strong; medioanal ventral seta small, black, hooklike, situated on a dark sclerite, characteristic for this species.

(463)



FIGURES 664 and 665. Neureclipsis bimaculata L. Pupa:

664 – left mandible, dorsal; 665 – plates of holding apparatus of abdominal segments 5–7.

Anal legs relatively short compared with other genera. Section "a" slightly longer than section "b"; distal transverse stripe indistinct, more distinct on the dorsal side; setae absent except a small mediodistal group, which continues in a dense, longitudinal row of secondary setae on the median surface of section "b." Laterodorsal sclerite of section "b" yellow; a dark brown spot with 2 setae near its base; a longitudinal dorsal row of 5 or

6 short setae; 2 black long setae, which are almost as long as the anal leg near the base of the articular rods; a similar but shorter seta on the outer side, separated from the dorsal setae by a small lobe-shaped process. Margin of sclerite with 7 setae ventrally; the dark basoventral seta longer than the others. A longitudinal group of setae in the middle of the section, near the basal margin. Sclerite "c" brownish, without seta.

Claw strongly curved, ventral side with a row of light spinules in the middle; the 2 distal spinules of this row longer than the others; the long seta 6 situated on the outer side; the long seta 5 situated basal to the transverse stripe; seta 8 situated ventrally; seta 7 very small, situated on a
463 membrane; membrane with a pit slightly more dorsally; seta 1 situated on the dorsal side, basal to the transverse stripe; the shorter seta 2 situated more apically; the long seta 3, the longest seta of the claw, situated in the basal part; the dark seta 4 situated on a membrane at the base of the claw.

**Pupa.** Length 8–11 mm. Antennae filiform, moniliform at the end, reaching abdominal segments 5–6 in male pupae; segments 4–5 in female pupae; first segment of antennae thicker, 2nd segment longer than the others; 1st segment with 2 dark, relatively long setae projecting in the same direction as the setae of clypeus and labrum. Anteclypeus very short, broad, separated from the labrum by a deep fold; its setae straight, dark, longer than setae of labrum and 1st-antennal segment; 2 of them situated laterally and one slightly more medially. Surface of labrum and anteclypeus, shagreened, striated, tuberculate in some places; 4 setae relatively long, forming a transverse row laterally; 2 small thin setae more medially; one of them near the anterior margin, the second slightly further from the margin; apical part of mandibles broader than in the other genera and less strongly curved, separated from the broad base by a fold; surface of mandibles tuberculate at the base; tubercles form dark denticles in the basal part of the ventral side; ventral margin of blades finely serrated (Figure 664).

464 Wing sheaths extending to abdominal segment 4. Fore tarsus with sparse natatorial setae on the first 3 segments, and with several setae on the 4th segment. First four segments of mid-tarsi with dense, light, thin natatorial setae, which are longer in the ventral row than in the dorsal row. Presegmental plates present on segments 3–8, postsegmental plates on segment 5. Presegmental plates of segments 3–5 small, strongly convex (Figure 665), broader posteriorly, with 6 blunt, short, posteriorly-directed denticles; postsegmental plates of segment 5 oblong, boat-shaped, concave, with 10 pointed, anteriorly-directed marginal denticles that are obliquely arranged near the lateral margin; convex presegmental plates of segment 6 of the same form as the postsegmental plates of segment 5, but situated further medially; plates of segments 7 and 8 like those on segments 3–4. Number of denticles as follows: III:5–6; IV:5–6; V:6 + 12–14; VI:15–16; VII:5–6; VIII:5–6.*

Gills of abdominal segments 2 and 8 with one filament; gills of segments 3–7 with two filaments on a common base. Lobes of last abdominal segment short, broad, with straight posterior margin, pointed inner angle and rounded outer angle; black moderately long setae posteriorly

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Siltala (1903:15) gives 3–9 denticles for segments 3–4, 7–8 and 8–15 and 7–13 denticles for the plates of segments 5–6; I have not seen such numbers of denticles.

and on the outer side. Outer appendages of male pupae extending farther posteriorly than the short, apically rounded penis sheath; segment 7 of female pupae with blunt, conical, ventral process.

Pupae lying in cocoons of loose grayish tissue; case with a thick covering of fine sand grains; pupal case attached to the same substrate as the capturing nets of the larvae; they are sometimes completely covered by the remains of the larval nets; they are dark brown because of the detritus accumulated in the nets.

Mode of life and habitats. Larvae predators; they build capturing nets in form of funnels with a widely open entrance and a curved, narrow end. They prefer rivers and rivulets in the plains with a moderately strong current and dense plant thickets; they often occur in large colonies, attaching their capturing net to plants or to the bottom; they live near the banks in large rivers or in deeper places among sunken branches or pieces of wood. They sometimes occur in large numbers in streams between lakes; they become well adapted to conditions in reservoirs when there is a rapid current; they were found in large numbers in the Tsimlyansk reservoir.

Distribution. The whole of the European USSR, Middle Asia (Amu-Darya), Siberia, Kamchatka. In addition, Europe, North America (rare).

## IX. Family ARCTOPSYCHIDAE Martynov

**Full-grown larva.** Length 18—20 mm. Head oblong, dorsoventrally compressed. Frontoclypeus with deep, lateral indentations and broad anterior margin; clypangulus small, dark, clearly differentiated. Frontoclypeus with a broad dark figure in the middle. Gula fused with pregula, oblong-wedge shaped, extending on the whole head to the occipital foramen. Dorsal stripes broad, dark, distinct; dots numerous.

Chaetotaxy of head and body of the larvae of Arctopsychidae (like that of Hydropsychidae) characterized by a rich, highly differentiated secondary chaetotaxy while spines are little developed. The setae of both families are divided into three groups: 1) primary setae, which are usually short, thin and pale; 2) ordinary secondary setae, which are numerous, of different form and size; they are longer than the primary setae in some places (anal legs); 3) small secondary setae of the covering tyoe, which differ markedly in size and form; unlike the ordinary secondary setae, these small covering setae are often called chetae; details on these setae are given in the descriptions.

Head sclerites, especially in dark areas, covered with short, thin curved setae. Primary setae short or moderately long; the longest setae straight, blackish and strong; secondary setae present near anterior margin of head in addition to primary setae.

Labrum with similar small covering setae as on the head; anterior half, middle and posterior part of labrum with numerous thick, black setae among which the primary setae are indistinguishable; tufts of light brown stiff hairs near the lateral margin, which are broad and pectinate. Mandibles massive, 465 long, their teeth large; chetoids of the median brush of the left mandible short; outer side of mandibles with numerous secondary setae.

Submentum trapezoidal, one seta in the anterior angles replaced by a tuft of setae with several longer and thicker setae; cardo and stipes also with secondary setae. Galea short; maxillary palps with short, broad segments. Mentum shining, brown; ventral sclerites with small, thick, light setae; labial lobe with short palps.

Dorsum of all 3 thoracic segments sclerotized; meso- and metanotum without median suture; their posterior half with a distinct transverse suture, which is a character of the family. Trochantin of meso- and metathorax free, not fused with episternum.

Abdomen slightly flattened dorsoventrally, with numerous small covering setae. Gills of thoracic segments situated at the base of midlegs and hind legs; they are also present on the ventral side on the metathorax; abdominal gills present on segments 1—7 or on segments 1—8, in two pleural and two ventral rows on both sides; each gill forms a small column with an apical tuft of filaments. Anal legs relatively long; dorsolateral sclerite of section "b" with an apical tuft of long, dark, secondary setae.

**Pupa.** Length 13—17 mm. Antennae long, reaching end of body in male pupae, slightly shorter in female pupae. Labrum short and broad, with numerous secondary setae. Mandibles long, blades serrated, several teeth larger than the others; a group of setae of varying lengths in the basal part on the outer side. Natatorial setae present only on the mid-tarsi.

Presegmental plates present on abdominal segments 3—8, postsegmental plates on segments 3—5. Gills present on segments 2—7 in a pleural and a ventral row. Anal rods broad and short, with divided end.

Pupa lying in a loose grayish sheath; case thick, made of small stones and sand grains.

Mode of life and habitats. The larvae build chambers and capturing nets with regular square meshes. They occur in running water on the bottom; mainly in rivers and rivulets with many rapids and stony, rubble-covered bottom or bottom covered with large pebbles.

Distribution. North of the European USSR, West and East Siberia, Amur Region, Maritime Territory, Kamchatka. In addition, northern Europe, China, Japan, India, North America.

## 1. Genus Arctopsyche McLachlan

This is the only genus of the family in the USSR.

### Key to Species of Arctopsyche

Full-grown larva

1 (2). Median dark stripe of frontoclypeus slightly concave in the middle, rhomboidal in the posterior part; posterior part of sclerite with a light, distinct, heart-shaped spot contiguous posteriorly with the bifurcation of the frontal sutures. Dorsum of thoracic segments with a longitudinal light median stripe . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **A. ladogensis** Kol. (p. 530)

2 (1). Median dark stripe of frontoclypeus nearly uniformly broad; margins of sclerite near bifurcation of frontal sutures slightly dark. Light median longitudinal stripe on dorsum of thoracic segments absent or indistinct . . . . . . . . . . . . . . . . . . . . 2. **A. palpata** Mart. (p. 539)

### 1. Arctopsyche ladogensis Kolenati

Siltala, 1905:111–114; Figure 26. – Lepneva, 1928:28–31, Table 1, Figures 1–11. – Flint, 1961:6–8, Figures 1–10.

**Full-grown larva.** Length 18–20 mm. Head slightly oblong (Figure 666), slightly flattened dorsoventrally; ratio of length to width 1:0.8. Head grayish yellow; stripes and spots brown, with coarse dark dots. Frontoclypeus wide, with deep lateral indentations. The truncate wedge-shaped gula extends along the whole head, dark anteriorly, posteriorly and laterally. A broad dark brown median stripe which is narrower in the middle on the frontoclypeus; it is rhomboidal posteriorly; a transverse curved row of small dots in the posterior part of the stripe; a row of 4 or 6 dots in the anterior third; 1 or 2 dark dots lateral to the stripe in the middle; lateral margins 466 narrowly dark anteriorly and posteriorly, light in the middle; posterior angle of sclerite light; dark lateral stripes on the posterior part sometimes contiguous with the lateral angles of the rhomboidal part of the stripe. Dorsal stripes of head broad, extending from anterior to posterior margin of head, closely contiguous to the frontal sutures and situated at a distance from the coronal suture; 3 light dots in the middle; posterior part with rows of fine dark dots. Space between median and dorsal stripes of head forming a characteristic light fork-shaped figure. Lateral stripes broad, with fine dark dots, which are often connected with the dorsal dots. Large groups of coarse dots ventrally at the sides of the posterior part. Dark stripes and spots (also light background in some places) with small, curved, light, covering setae which have distinct alveoli (Figure 668).

Primary lateral seta and intermediate seta of the anterior-margin setae of the frontoclypeus very thick, dark and long; median seta shorter, lighter and slightly thinner; near it an almost equal or longer secondary seta; 3 or 4 similar long setae situated near and between the other two anterior-margin setae; several light, soft, small setae at the anterior margin.

Frontal setae light; anterior frontal seta slightly curved inward; several similar, small, light, secondary setae near it; middle frontal seta light, short, situated near curvature of the frontal sutures, inside the dark dot; posterior frontal seta indistinguishable from the sparse secondary covering setae. Clypangulus dark, with thick, dark, short setae; 1–5 dark and light additional setae posterior to it. The primary seta 9, near the frontal suture 467 is the thickest, darkest and longest seta of the head; it is slightly longer than the long anterior-margin setae; posterior to it, near the suture, at a marked distance from the eye, is the small dark seta 11; seta 7 dark, shorter and thinner than seta 9, situated near the dorsal articulation of the mandibles; the small antennal tubercle with 3 thin light setae is situated anterior to seta 9 near the margin; the similar, thin seta 8 is situated more ventrally near the margin; the short seta 10 is situated laterally, behind it; setae 12 and 14 and several small secondary setae are situated posterior to the eye; setae 16 and 17 light; seta 17 situated near the eye. Ventral seta 18 small, little marked.

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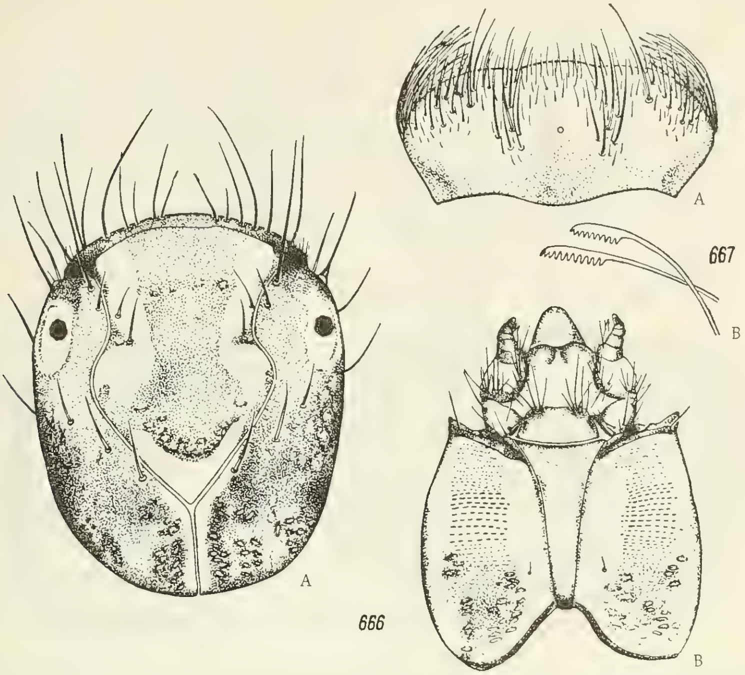

FIGURES 666 and 667. Arctopsyche ladogensis Kol.:

666 — head, dorsal (A) and ventral (B) (secondary setae shown only partly; covering setae not shown); 667 — labrum, dorsal (A), pectinate hairs of anterior-angle tuft (B).

Anteclypeus pale, relatively short. Labrum (Figure 667) short and broad; ratio of length to width 1:2.3. Anterior margin of labrum narrowly membranous; median indentation of dorsal sclerite replaced by a small tubercle covered with short dark hairs; sides of anteclypeus near the membranous margin with a dense tuft of golden brown hairs which are flattened, and finely serrate at the end (Figure 667, B). Dorsal sclerite pale yellow, brownish at the sides in the anterior third with a broad brown longitudinal indistinct median stripe in the middle; posterior angles and posterior-angle sclerites dark brown. Anterior part of labrum and area lateral to the dark median stripe with numerous dark brown and brown setae, 2 of which are longer (primary setae 5 and 6).

Mandibles massive, dark brown and long. Left mandible with 2 large apical teeth; upper blade with a small tooth; lower blade with 4 teeth, the basal tooth indistinct; median brush consisting of short light chetoids; a small brush of small light hairs near the basal tooth. Outer surface of mandibles with light yellow setae of varying length; 16 or 17 such setae on the left mandible, and 14 or 15 on the right mandible; there are also several small light hairlike setae.

Pregula fused with gula; anterior margin of sclerite slightly projecting anteriorly.

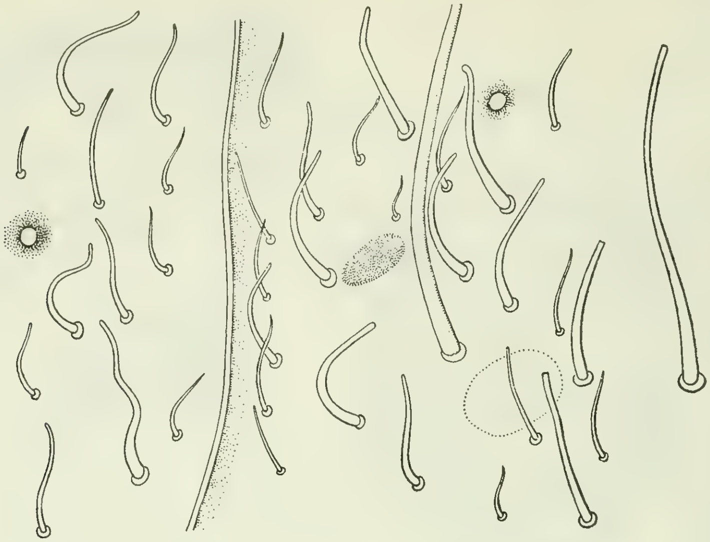

FIGURE 668. Arctopsyche ladogensis Kol. Setae of dorsal side of head

Cardo with 9 thick brown setae and several thin light setae at the base and laterally. Submentum (Figure 666, B) brown, trapezoidal; anterior margin of submentum slightly concave; a tuft of 5 or 6 dark brown, thick setae and 4 or 5 thin, light setae near the anterior angles; a longitudinal row of small, light setae parallel to the lateral margin. Apical margin of stipes dark brown, a dark stripe at the base; primary lateral seta replaced by 2 thick, dark brown and 6 short, thin, brown setae; a group of 8 or 9 setae nearby; 2 thick and 2 small, thin setae in the middle. Membrane near distal margin with a group of small setae. Palpifer dark brown laterally, lighter in the middle; distal seta short and brown, thick, situated not on the membrane, as usual, but on the sclerite, near the margin; second (median) 468 seta light, small, situated near the basal margin; short light hairs present on the membrane. Maxillary palps short, narrower apically; first segment broader than the others. Galea small, adpressed to the palp, with dark brown sclerite and light yellow setae and hairs. Mentum relatively long, brown, with a dark brown band; apical part of labium hemispherical and light; ventral rods absent; the setae replacing them light; labial palpifer light brown on the outer side; labial palps very small; short, light hairs present at the end of the labium, around the opening of the spinning glands.

Pronotum wide, covering also the sides of the segment. Pronotum mainly reddish brown, with a whitish yellow median stripe along the suture, yellowish posteriorly, on the sides; anterior margin reddish brown; posterior margin and most of the lateral margin black or brownish black in some places; each half of sclerite with oblong groups of dots. Sclerite, except the parts with dots, with small, reddish brown covering setae interspersed with small light hairlike spinules. Anterior margin with blunt anteriorly-directed spinelike brown setae, which are uniformly distributed, numbering 38—40. Primary and a few secondary surface setae of the ordinary type, thin and short; anterior-angle seta light, small, situated near the margin; anterior third of sclerite with a short yellowish seta near the median stripe; 2 similar small, lighter setae lateral to this seta, nearer the anterior margin; a relatively large, light brown seta (medioanal seta?) in posterior half of sclerite near the light median stripe; 2 small light setae near the suture; a small light seta in the middle posterior to the anterior group of dots.

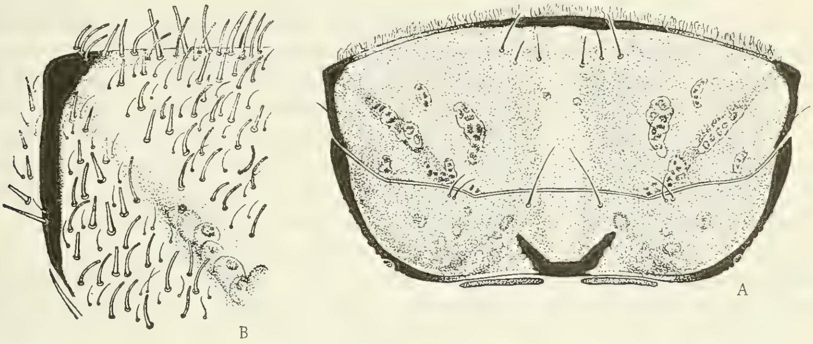

FIGURE 669. Arctopsyche ladogensis Kol. Mesonotum (A) and covering setae on the left side (B)

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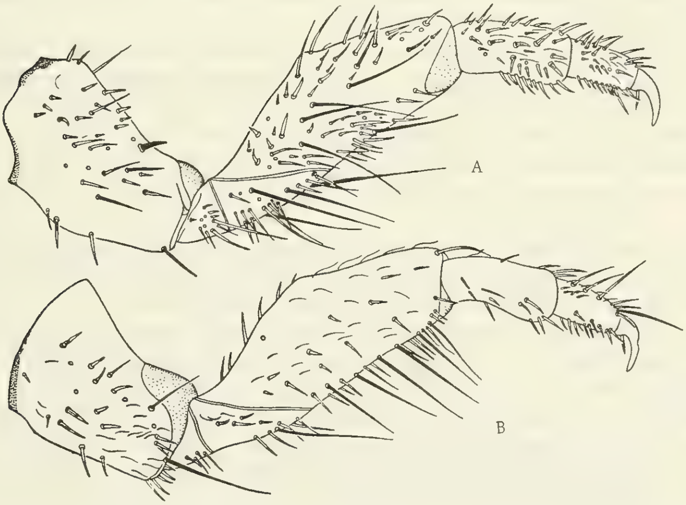

FIGURE 670. Arctopsyche ladogensis Kol. Left foreleg, anterior (A), right foreleg, posterior (B)

Meso- and metanotum (Figure 669) larger than pronotum; color of background and covering setae similar, thinner and sparser on metanotum; light median stripe is broad. Numerous small dots and a dark stripe extending obliquely from the anterior angle to the curvature of the transverse suture anteriorly; larger and sparser dots posterior to the suture. Minute setae at anterior margin shorter, thinner and slightly lighter than on pronotum, but more numerous, 70—80 on mesonotum and 50—55 on metanotum; surface setae concentrated in anterior third and posterior to the transverse suture; a relatively large, light brown seta and 2 smaller light setae medial to it in the anterior third, at a distance from the light stripe; one seta laterally, anterior to the median group of dots, closer to the anterior margin; a long light brown seta (medioanal seta?) posterior to the suture near the median stripe, 2 small, light setae situated lateral to the curvature of the suture.

Pleural sclerite of prothorax yellowish brown, slightly oblong, irregularly quadrangular, with dark pleural suture from the posterodorsal angle to the anteroventral angle; a large black spot near the end of the suture in anterior
469 part of episternum and in posterior part of epimeron; episternum convex, with indistinct large grayish spots; epimeron with a thin brownish primary seta near the rounded posterior angle and several secondary setae, which form reddish brown, short spinules or smaller hairlike spinules. Trochantin free, conical; primary seta straight, thin, relatively long in middle of the ventral margin; both setules light, whitish, situated on a membrane near the distal end; dorsal side with 2 thick and several thin spinules.

Pleural sclerites of meso- and metathorax of irregular form, with pointed dorsal angles; posterior margin of epimeron rounded; anterior margin of episternum concave; pleural suture brown basally, light in the middle, broadly blackish brown apically, continuing in the broad apical margin of the episternum; epimeron with indistinct, grayish coarse dots; epimeral seta near margin short, straight, light; sclerite also with 8 thin and thick spinelike setae. Trochantin tongue-shaped, not fused with episternum; its basal margin brown; seta at its base straight, dark brown, longer than epimeral seta; 3 spinelike setules, 2 primary and 1 secondary seta slightly further distally.

Anterior margin of large sternite of prothorax narrowly blackish brown, with a blunt median process; a transverse curved groove at which the sclerite is inclined at an obtuse angle in the middle; posterior part of sclerite with a quadrangular reddish brown spot in the middle.

Mesothorax with one tufted gill near the base of the legs; such a gill also on the metathorax near the base of the legs and ventrally near the midline.

Covering setae of membranous areas of thoracic segments as dense and small as on the sclerites but lighter and softer; a similar covering present on the membranous surface of the abdominal segments.

Forelegs (Figure 670) prehensile, short, directed anteriorly; midlegs and especially hind legs much longer; ratio of length of legs: 70:100:110. Legs brown, without dots or with small indistinct dots; sclerites with brown, curved, covering setae, which are either very small or slightly longer; they are uniformly interspersed with thin light hairlike setae adpressed to the sclerite. Primary and secondary setae dark, blackish brown, brown or yellowish. Chaetotaxy of legs rather variable.

Distodorsal indentation of fore coxae less than half as long as the segment; 470 6 or 7 dark dots near the basodorsal depression; 2 primary setae dorsally among the minute spinelike setae, at the projecting comblike anterior margin: a basal thin brown seta and an apical black, thick, long spine; posterodorsal seta near the apical margin short, strong, blackish brown; a black, strong, short, spinelike seta and two similar long, thin, brown setae anteriorly, among the small and covering setae; small setae and several long setae posteriorly; both primary distoventral setae black and strong; anterior seta slightly shorter than posterior seta; 6 or 7 small, spinelike, thin, light setae between them.

First segment of trochanter with several, short, light setae; second segment with a dark, long, primary anterior seta in about its middle; posterior surface seta shorter and black, situated subventrally; ventral covering setae light, slightly curved, setuliform; among them 2 long, posterior, black primary ventral setae (including a subapical seta, which is one of the longest setae of the leg) and 3 anterior light setae; basal seta straight, situated between segments 1 and 2.

Femur with strongly convex dorsal margin which forms an obtuse angle in the middle; anterior surface of femur convex, posterior surface slightly concave; ventral margin straight. Covering setae dorsally and subdorsally larger and thick anteriorly, sparser and small posteriorly, long and pointed ventrally, forming thin light, slightly curved, spinelike setae.

Two short setae dorsally, at the angle; one of them primary; distodorsal primary seta moderately long, blackish brown, strong, slightly displaced posteriorly; a longitudinal row of several long, thick, blackish brown setae anteriorly; an anterior group of dense, similar dark, large setae subventrally; a dark strong seta (primary posterior seta) subventrally near the apex; numerous long, light yellow setae in one row, close together ventrally; 5—6 sparse black setae posterior to these setae.

Tibia short, curved at the base; small sparse setae dorsally and posteriorly; dense, slightly curved, reddish brown spinelike setae which are arranged in a regular row in the subventral region anteriorly; a straight, yellowish moderately long seta distally and dorsally; a similar slightly curved seta situated anteriorly, near the apex; a row of light, thick, spinelike setae which are larger apically on the ventral side; a short, primary, blackish brown seta subventrally on the posterior side near the apex.

Tarsus short; large covering setae arranged in rows; anterodorsal row consisting of brown spinelike setae; posterior row of thin straight light setae; sides with 2 comblike rows of light spinelike setae which are larger apically on the ventral side. Apex of tarsus with 2 primary distodorsal brownish, strong, short setae; anterior seta slightly longer than posterior seta.

Claw curved, dark brown, with a strong, yellow, basal seta.

Coxae of midlegs and hind legs (Figure 671) long, with an apicodorsal indentation, which is about half as long as the segment; basodorsal groove dark, with indistinct small dots. A basal primary seta dorsally, near the anterior margin, which is straight, short, darker on the hind legs than on the midlegs; apical seta moderately long; 3 or 4 additional short setae near it, at the anterior margin of the indentation; midlegs with 2 black setae and 3 short dark setae posteriorly and dorsally; only small covering setae posteriorly. A narrow almost bare stripe ventrally; 2 black primary setae, an anterior and a posterior seta ventrally, near the apex; 6 short, light spinules between them; several black shorter setae on the sides.

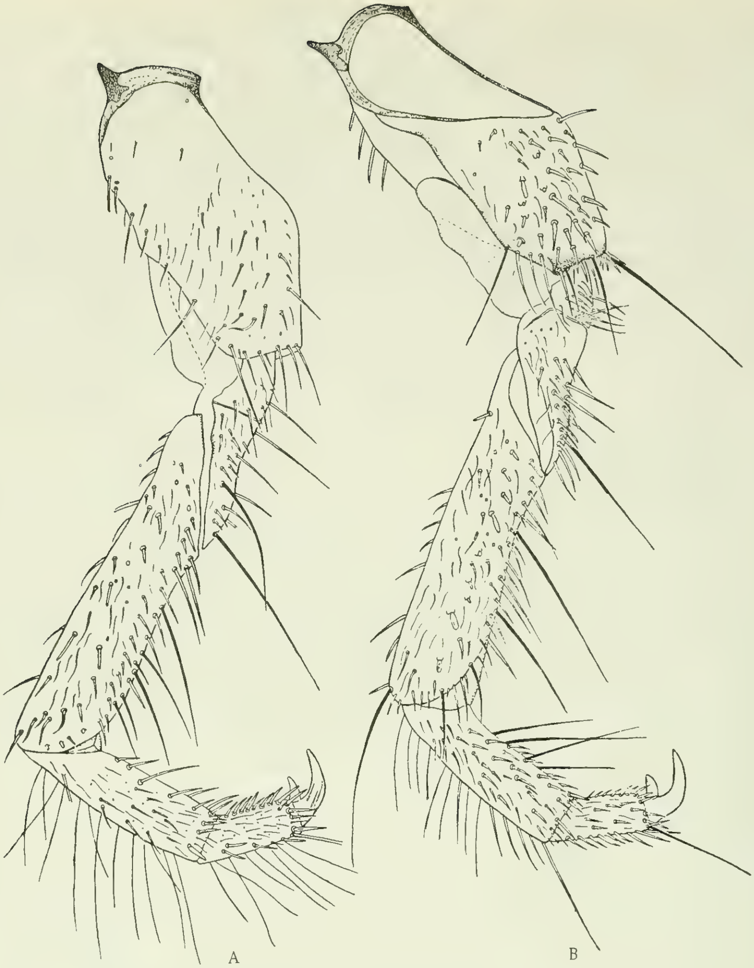

FIGURE 671. Arctopsyche ladogensis Kol. Right hind leg, anterior (A), left hind leg, posterior (B)

Trochanter of midlegs and hind legs not closed with small light setae anteriorly and posteriorly; primary, anterior, basoventral seta straight, long, light brown, situated almost on the same suture on the midlegs; situated basally on the 2nd segment on the hind legs; 2nd segment with a dark stripe near the anterior margin; a dark spot ventrally; posterior setae coarser and thicker; ventral setae few in number; anterior and posterior setae of midlegs dark brown; setae on hind legs lighter and thinner; distoventral seta blackish brown, longer than the others.

Femur straight, slightly flattened laterally; dorsal side of mid-femur yellowish brown, with indistinct spots. Covering setae on the midlegs spinelike dorsally and posteriorly, reddish brown, short, thin, sparse and light on the hind legs. A short, blackish brown, posteriorly displaced

primary basodorsal seta situated distally and dorsally, on a dark spot, among the secondary setae; 6—8 thick black long setae ventrally; rows of short or long spinelike setae anterior and posterior to them; 1 or 2 black
471 setae anteriorly and 2 or 3 setae posteriorly, in addition to spinelike brown setae.

Mid-tibia ventrally with an anterior row of 4 long black setae and 2 shorter light setae and a posterior row of 7 spinules, which are longer apically; thin sparse setae and a curved distal seta and a straight light seta in the middle of the dorsal side; the latter seta longer than the others; posterior primary seta dark brown, distinct, situated subventrally near the apex. Tibia of hind legs longer than tibia of midlegs; it bears numerous soft long thin setae on the dorsal side which are small and light anteriorly; there are also several subventral setae which are strong, brown and spinelike; small subdorsal setae posteriorly; other surface with large covering setae; ventral setae long and black.

472 Fore and mid-tarsus with sparse, light setae dorsally, with a dark (primary) distodorsal seta and a short, light seta; small covering setae anteriorly and posteriorly; 2 rows of short brown spinules ventrally. Hind tarsi dorsally with numerous, thin, light setae and 2 primary distodorsal long, blackish brown setae; anterior surface with light covering setae; posterior surface with sparser spinelike setae; distal half ventrally with small setae in 2 irregular rows; these setae form strong brown spines, which are longer apically.

Claw strong, dark brown; basal seta forming a massive spine.

Abdomen uniformly broad from segment 1 to segment 4, tapering posteriorly from segment 5; segment 9 narrow, small. Small covering setae dark, curved; among them sparse, straight setae, with irregular, apparently broken ends. Primary setae thin, relatively short. A pattern of white, bare stripes and spots among the covering setae.

Gills of segments 1—8 arranged in 4 rows, 2 pleural rows and 2 ventral rows (Figure 672); gills of pleural rows situated dorsally and ventrally to the white lateral stripe; postsegmental gills situated dorsally to the stripe; gills in middle of the segment ventrally to the stripe. Number of filaments on the gills in the ventrolateral row the largest. Distribution of gills and the number of filaments given in Table 11.*

Medioanal gills on the metathorax situated close together.

Primary dorsal setae thin, short, light yellow; anterior-angle setae slightly longer and thicker than the others, restricted to the end of the transverse white stripe, situated in about the middle of the segment; anterior-margin setae small, distinguished with difficulty from the light setae on the segment; relatively large medioanal seta slightly shorter than anterior-angle setae; other 2 surface setae near it thin and light; these setae dark on segment 8, and lateral seta as long and as thick as median seta.

Ventral side of segments 1—8 with a small dark seta (one of the primary setae) near the base of the gills; segments 7 and 8 without median gills, with a small, light plate near the posterior margin, which is larger on s segment 8 and posteriorly surrounded by massive brown covering setae; a strong brown seta near posterior margin of plate of segment 7; segment 8 with 3, sometimes 4—6 such setae.

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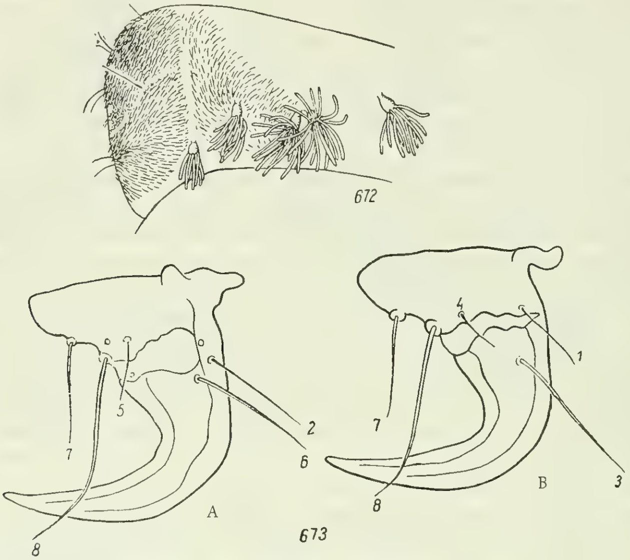
* According to counts from specimens from Karelia, Pechora, Bia and Yenisei rivers; higher figures are given by Siltala for larvae from Finland (1905:113).

TABLE 11

| Segment | Pleural | | Ventral | |
|---|---|---|---|---|
| | | | lateral | median |
| Mesothorax | – | – | 21–25 | – |
| Metathorax | – | – | 18–20 | 19–20 |
| 1 | – | – | 16–18 | 18–20 |
| 2 | – | 9–14 | 14–15+17–20 | 15–16 |
| 3 | 8–10 | 9–12 | 11–15+13–14 | 12–14 |
| 4 | 8–11 | 10–12 | 10–15+12–15 | 12–13 |
| 5 | 7–8 | 9–13 | 11–12+12–13 | 12–13 |
| 6 | 8–9 | 10–11 | 10–12+12–14 | 8–9 |
| 7 | – | 8–12 | 6–8+8–9 | – |
| 8 | – | – | 5–8+5–6 | – |

(473)



FIGURES 672 and 673. Arctopsyche ladogensis Kol.:

672 – gills of middle segment, ventral; 673 – claw of left anal leg, outer view (A), inner view (B).

Segment 9 with 2 weakly sclerotized yellowish sclerites with minute covering setae dorsally, in the anterior half; a small band of such setae situated posteriorly between the sclerites. Posterior half of sclerite light, without setae; this part of the sclerite covered by the fold between segment 9 and the anal legs in the normal position; transverse anal slit situated near the posterior margin. Five anal gills. Primary dorsal setae situated at the posterior margin of the sclerites, displaced to the anterior half of the segment; medioanal seta longer and thicker than the others, light brown; anterior-angle seta similar, slightly smaller; a light, smaller

seta anterior to the medioanal seta and near the anterior angle. Sides of segment with 2 large, blackish brown, thick setae (primary lateral setae),
473 a long anterior seta and a shorter posterior seta on a small yellow sclerite; 2 wide, light yellow, thin sclerites separated by a narrow median stripe, on the ventral side; they are densely covered with covering setae of 2 types, large, massive, brownish yellow, setuliform setae with long, thin ends, interspersed with small, light setae; thick, black setae of varying length near the posterior margin of the sclerites.

Anal legs long; section "a" broad and short; section "b" longer; dorsolateral sclerite light yellow, extending partly to the ventral side at the base; basal margin reddish brown. Dorsal side of sclerite without covering setae, with a row of thin, moderately long, sparse setae at the inner margin; 2 long, thick, primary setae dorsally, above the claw; a row of strong, dark, setae which are short in the basal part, distally and subventrally along the margin; a longitudinal row of thin, golden brown setae which are denser and longer in the apical part, in the middle of the outer side. Distal margin of sclerite "a," unlike in the other larvae of Annulipalpia, with a narrow, brownish black plate covered with long golden brown setae which form a dense fan-shaped tuft, in addition to the articular process. Articular process asymmetrical; its median branch with a narrow, blackish brown outer margin with a process in the middle which has a thin end which surrounds the plate at the base of the fan-shaped tuft from the ventral side. Sclerite "c" brown, trapezoidal, with a strong black seta in the mediodistal angle.

Claw (Figure 673) relatively small, dark brown, bent at a right angle; membranous transverse stripe narrow; basal part short. Dorsal side with the short seta 1 and the long seta 2 near the transverse stripe; seta 6 on the outer side; inner side with seta 3; long setae 8 and 7 thick, light, situated ventrally; seta 8 longer, curved, reaching end of claw; outer side subventrally, with the dark seta 5; inner side with the light yellow seta 4; both setae small.

Mode of life and habitats. Running water, on stones and other objects; predacious, building capturing chambers with nets with regular quadrangular meshes; feeding on plankton and benthic animals. Mainly
474 occurring in rivers and rivulets with many rapids, including large rivers; they have been recorded from rivers and rivulets in the basin of lakes Onega and Ladoga, and also from the Neva, Sviri and Pechora rivers and rivulets; they are widely distributed in Siberia, in the Biya and Yenisei rivers. Adults fly in large numbers (Lepneva, 1948a).

Distribution. North and northeast of the European USSR, West and East Siberia. In addition, northern Europe, Mongolia, North America.

### 2. **Arctopsyche palpata** Martynov, larva nova

**Full-grown larva.** Length 18.5—19.0 mm. Head (Figure 674) darker than in A. ladogensis; main color reddish yellow; dots black; covering setae smaller and sparser; primary thick setae black or brownish black. Frontoclypeus less broad, with less deep lateral indentations. Dark longitudinal median stripe of sclerite uniformly broad, not narrowing in the middle, slightly rounded posteriorly. Margin of sclerite dark near the clypangulus and near the bifurcation of the frontal sutures; posterior stripe contiguous laterally with the posterior margin of the median dark figure. Unlike in A. ladogensis, light spot in posterior part of sclerite of A. palpata smaller. Several small dots and a row of 5 or 6 coarser dots near the posterior end of the median stripe; groups of 3 or 4 dots anterior to them at the sides; a transverse row of 6 dots (3 dots on each side anteriorly); a transverse process with a black dot and a brown, spinelike mediofrontal seta in the middle, where the sclerite is narrow.

Dorsal stripes at level of eyes sometimes interrupted or pale; dots on stripes black or blackish brown, forming longitudinal rows along the coronal suture; dots on sides of head also numerous, forming irregular longitudinal rows on the light background; groups of small, light brown dots ventrally near the occipital margin and 3 large dark dots on each side anterior to them. Setae of head as in A. ladogensis but darker; seta 9, black; seta 7, dark brown; setae 17 and 18, light brown, distinct. Covering setae, smaller and sparser than in A. ladogensis, present in small numbers on the dark figure.

Dorsal sclerite of labrum (Figure 675) darker than in A. ladogensis; pattern less distinct; posterolateral reddish brown spots smaller; median spot near posterior margin little marked; covering setae very small, light; secondary surface setae strong, reddish brown, less numerous than in A. ladogensis; serration at end of yellow lateral hairs more distinct and coarser.

Teeth of mandibles (Figure 676) slightly blunt. Distally, left mandible with 2 blunt, indistinct teeth and a small denticle between them; upper blade with tooth; lower blade with 3 teeth and a basal tubercle; 6 yellowish thicker and longer setae and a similar long, strong, dark brown seta among the numerous light outer setae. Distal tooth of right mandible blunt; upper blade with one tooth, lower blade with 3 teeth, basal tooth very small; middle tooth larger than others; outer setae of varying length and thickness.

Sclerites of maxillolabium reddish brown; submentum with slightly concave anterior margin and convex lateral margin; 4 and 5 anterior-angle setae longer than the others; cardo with 5 blackish brown setae at the inner
475 angle near the base; 1 of these setae long; sclerites with thin, light setae and several thick brown setae; stipes reddish brown; basal group of dark setae, 2 of which are longer and thicker than the others; distal group with 1 such seta.

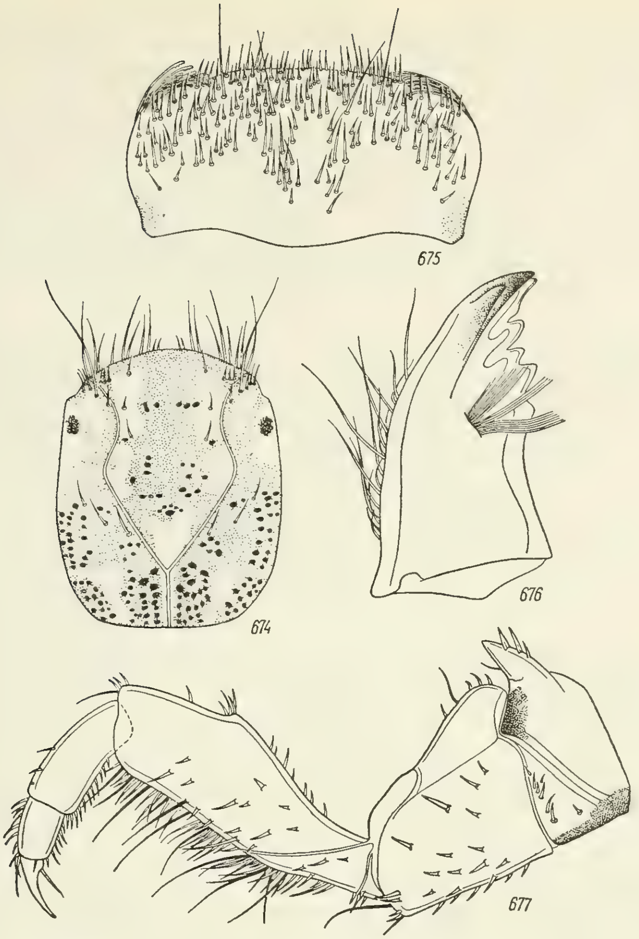
Light mediolongitudinal stripe of nota of thorax absent; pattern of meso- and metathorax distinct; lateral margins broadly black; median spots of posterior margin as in A. ladogensis; anterior margin darker in the middle.

Legs lighter and thinner than in A. ladogensis (Figure 677); secondary setae of midlegs and hind legs less numerous.

Abdomen similar, with a light pattern and with the same primary and secondary setae as in A. ladogensis. Distribution of gills listed in Table 12.

476 Medioventral seta of segment 7 dark, situated near the posterior margin on a small sclerotized dot; segment 8 without gills; ventral plates small, thin, yellowish, fused in the middle; a narrow, reddish brown stripe with 4 short, strong, black setae near the posterior margin.

(475)



FIGURES 674–677. Arctopsyche palpata Mart.:

674 – head, dorsal; 675 – labrum; 676 – left mandible, dorsal; 677 – propleuron and left foreleg, posterior.

(474) TABLE 12

| Segment | Pleural | | Ventral | |
|---|---|---|---|---|
| | | | lateral | median |
| Mesothorax | – | – | 13–16 | – |
| Metathorax | – | – | 14–18 | 19–21 |
| 1 | – | – | 17–22+0–0 | 21–24 |
| 2 | – | 7–7 | 13–11+12–15 | 17–18 |
| 3 | 5–6 | 7–7 | 12–14+12–13 | 14–17 |
| 4 | 6–7 | 7–8 | 11–12+11–13 | 12–12 |
| 5 | 7–7 | 7–7 | 12–14+11–12 | 11–12 |
| 6 | 7–7 | 7–7 | 11–12+10–11 | 6–6 |
| 7 | – | 7–7 | 7–8+7–0 | – |

Dorsal sclerites of segment 9 yellowish, thin, with indistinct dots near the anterior margin; a reddish brown, thin seta near the posterior margin; 4 or 5 minute brownish setae in some places. Ventral plates of segment large, brownish, covering greater part of segment, divided by a narrow membranous stripe in the middle; surface with small, spinelike yellowish covering setae; 12–14 large, reddish black setae near the posterior margin.

Dorsolateral sclerite of section "b" of anal legs light brown, with sparse, small, dark dots; basal margin of sclerite broadly black, brownish yellow ventrally. Setae as in A. ladogensis; setae darker and fewer; setae of posterior tuft less numerous and long than in A. ladogensis. Sclerite "c" and claws similar.

TABLE 13

| Segment | Number of spines | |
|---|---|---|
| | male | female |
| 3 | 0–7 | 17–20 |
| | 19–20 | 26–27 |
| 4 | 6–7 | 11–12 |
| | 3–4 | – |
| 5 | 6–7 | 8–12 |
| | 16–20 | 26–27 |
| 6 | 10–11 | 15–15 |
| 7 | 10–12 | 14–17 |
| 8 | 8–7 | 12–14 |

TABLE 14

| Segment | Male | | Female | |
|---|---|---|---|---|
| | pleural | ventral, lateral | pleural | ventral, lateral |
| 2 | – | 6; 5+10 | – | 9; 9+15 |
| 3 | – | 6; 10+12 | – | 7; 12+12–14 |
| | 8 | – | 8–10 | |
| 4 | 6 | 11; 9+10 | 6 | 14+12 |
| | 6–7 | – | 9 | – |
| 5 | 6 | 10+11 | 7 | 12–13+14–15 |
| | 6–8 | – | 8 | – |
| 6 | 7 | 5+11 | 7 | 10+10 |
| | 6–7 | | 7 | |
| 7 | – | 7+5 | – | 7+5 |
| | 8–9 | – | 11 | – |

**Pupa.** Length of male pupae 13–14 mm, of female pupae 16–17 mm. Antennae of female pupae reaching end of abdominal segment 6, those of male pupae almost reaching end of body. Anteclypeus short and broad; sides with 3 setae situated close together near the posterior margin, and 3 setae near the lateral margin; median and lateral setae of this row longer and thicker than the others. Labrum with rounded anterior margin and numerous setae, 4 of them thicker and longer; an indistinct dark spot posteriorly in the middle.

Mandibles with broad, massive basal part and a long apical part with slightly concave, serrated inner blade; 4 small denticles among the serrations.

Wing sheaths of female pupae reaching beginning of segment 4, those of male pupae beginning of segment 5. Natatorial setae light, present on segments 1–4 of mid-tarsi. Presegmental plates present on segments 3–8, postsegmental plates with anteriorly-directed spinules on segments 3–5; number of spinules given in Table 13; they are more numerous in female pupae than in male pupae.

Postsegmental plates on segment 4 very small, those on segment 5 dark brown and large as on segment 3; spinules of postsegmental plates small, 477 forming several rows; presegmental plates light brown; large dark spines forming a row near the posterior margin; several smaller and thinner spines near them on some plates.

Gills present on abdominal segments 2–7, forming a pleural and a ventral row; stalks of pleural gills thick, forming flattened lobes which are narrower apically; stalks of abdominal gills straight and thin. Both pleural gills situated postsegmentally, close together, one behind the other; anterior gill situated slightly more ventrally; ventrolateral gills form a row; 2 gills on a common base; median row absent; segments 2, 3, sometimes also 4, with an additional small gill lateral to the double gill (Table 14).

Anal rods broad and short, dark brown at the end and curved upward, divided into 2 flattened lobes; median lobe larger than lateral lobe; numerous thin, blackish brown setae laterally and ventrally; ventral side with 3 longer, thick, light, curved setae near the base of the lobes; female pupae with 2 additional but thinner setae.

Mode of life and habitats. Small cool brooks and rivulets; Sitsa and Ugodinza rivulets of Maritime Territory.

Distribution. Maritime Territory of the USSR. In addition, North China.

## X. Family HYDROPSYCHIDAE Curtis

**Full-grown larva.** Length 14–22 mm. Head usually more or less flattened dorsally, convex ventrally. Antennae as in Arctopsychidae, situated near the margin of the head, in form of small membranous tubercles, with 3 sensillae and 2 thin light setae; eyes small, situated near the anterior margin. Frontoclypeus with curved sides, without curvature near the tentorial pits, which are situated inside the frontal sutures. Gula small, triangular, fused with pregula, sometimes situated outside the head capsule.

Chaetotaxy of head and body resembling that of Arctopsychidae, rich, highly differentiated; primary setae not always fully developed; some of them small, thin, indistinct among the secondary setae. Secondary setae numerous, highly differentiated, represented by ordinary setae resembling the primary setae and by minute covering setae all over the body, and which differ strongly in form and size; these setae were illustrated in detail by Siltala (1907:358—359). We frequently name the small covering setae "chetae" or "covering chetae" which means setae with a distinct alveolus and not chetoids of the group of spines.

Labrum with a broad membranous anterior and lateral margin; dorsal sclerite yellowish, sometimes dark in some places, with long posterior-angle sclerites which are curved and reddish black at the end; membranous margin with long and short hairs (hairlike spines) laterally and in the middle which are different in the 2 subfamilies; sclerite also with numerous short secondary setae, including covering setae in addition to the primary setae.

Mandibles massive, with large teeth; penicillus in median depression of left mandible present or absent; outer side of mandibles slightly concave, with primary and secondary setae.

Cardo, submentum and stipes with numerous secondary setae.

Nota of all thoracic segments sclerotized; meso- and metanotum without median suture; posterior margin of mesonotum with a characteristic curved spot, rarely with a spot of different form; posterior margin of metanotum with a small, dark, median spot, sometimes with a black dot, or spot absent.

Abdomen with small brownish setae adpressed to the surface (absent in the genus Aethaloptera). Gills present on segments 1—7, rarely on segments 1—6 or 1—8, on the pleural and ventral surface; gills with a stalk and filaments.

Segment 9 or segments 8 and 9 ventrally with 2 brownish sclerites separated by a narrow median membranous stripe; sclerites with dense long and short covering setae.

Anal legs long; apex of sclerite of section "b" with a narrow, dark, ventrally curved plate with a dense tuft of dark setae which form a fan, in addition to the articular process; this plate is small, with several setae
478 in the subfamily Macronematinae. Sclerite "c" relatively large, with a long, strong, dark seta. Claw short, bent at a right angle, with ordinary primary setae.

**Young larva.** It shows primitive characters in the 1st stage and is colorless; primary chaetotaxy simple; some primary setae are feathered; gills absent; legs uniformly developed; claws of legs (unlike in the 2nd stage) with a thin, spinelike process near the base in addition to the primary seta. Sternal sclerites of abdominal segments 8 and 9 absent.

An indistinct pattern appears on the head in the 2nd stage; secondary setae and isolated ventral gills appear on abdominal segments 2 and 6; the small distal tuft of long setae is already present on the anal legs.

The coloration becomes more distinct in the 3rd stage; the number of secondary setae increases; pleural gills appear and the number of ventral gills increases.

The color of the larva of the 4th stage resembles that of the full-grown 5th-stage larva, but the pattern is less distinct; number of gills and secondary setae smaller than in the full-grown larva.

**Pupa.** Length 8–14 mm. Antennae slightly shorter than body, as long as body or markedly longer, coiled several times around the posterior end of the body. Labrum rounded anteriorly; setae primary and secondary. Blade of mandibles serrated, with several large denticles. Wing sheaths blunt, reaching abdominal segments 4–6. Mid-tarsi with dense natatorial setae. Presegmental plates present on segments 3–7 or 3–8, postsegmental plates on segments 3–4. Gills present on abdominal segments 2–7, 2–6 or 2–8. Anal rods with a deep incision or pointed and narrow at the end; setae on outer side numerous.

Pupa lying in a thick grayish cocoon; case made of sand grains and small stones in form of a cave or in a tube covered with sand and with an operculum at the anterior end in the Macronematinae.

Mode of life and habitats. Predacious (except the Macronematinae); building capturing nets with regular quadrangular meshes; living in brooks, rivulets and rivers of various types, including large rivers in the plains.

Distribution. Throughout the European and Asian parts of the USSR. In addition, cosmopolitan.

## Key to Subfamilies

### Full-grown larva

1 (2). Anteclypeus not sclerotized. Gula small and triangular. Submentum with 2 broad anterior lobes divided by a narrow median membranous stripe. Segments 8 and 9 ventrally with 2 yellowish triangular sclerites which are densely covered with setae. Anal legs long; sclerite "b" medially to the articular process with a downward-curved narrow plate with a tuft of dense, long, dark setae which form a fan at the apex . . . . . . . . . . . 1. **Hydropsychinae** Ulm. (p. 546)

2 (1). Anteclypeus with 2 dark sclerites in some genera. Gula large, fused with pregula outside the head capsule. Submentum different without anterior lobes. Ventral sclerites of segment 8 absent; sclerites of segment 9 small. Anal legs shorter; distomedian plate of sclerite "b" small, with few setae . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Macronematinae** Ulm. (p. 591)

### Pupa

1 (2). Antennae reaching or almost reaching end of body. Anal rods curved upward, with a deep incision . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Hydropsychinae** Ulm. (p. 546)

2 (1). Antennae long, coiled several times around posterior end of body. Anal rods tapering . . . . . . . . . . 2. **Macronematinae** Ulm. (p. 591)

## 1. Subfamily HYDROPSYCHINAE Ulmer

**Full-grown larva.** Length 14–20 mm. Frontoclypeus broad, without lateral indentations. Labrum short and broad; tufts of long hairs, which are broadened like combs at the apex, laterally near the anterior margin. Median depression of left mandible with a penicillus. Submentum anteriorly with 2 broad lobes divided by a narrow median stripe. Mesonotum with a black, curved spot in the middle of the posterior margin; median spot at posterior margin of metanotum small, black. Trochantin of prothorax
479 with a basal hornlike process so that it appears forked. Claws of legs with an ordinary basal seta.

Ventral side of segments 8 and 9 with paired, yellowish, triangular sclerites densely covered with thick, long setae. Anal legs relatively long; sclerite "b" with a median plate with a dense tuft of numerous long setae forming a fan at the apex.

**Pupa.** Length 8–15 mm. Antennae as long as body or slightly shorter, Labrum with numerous, short, secondary setae, mainly anteriorly, Mandibles long, slightly curved; blade serrated; several denticles longer than the others; outer setae situated in the basal part, numerous.

Wing sheaths blunt, reaching abdominal segments 5–6. Natatorial setae present on segments 1–3 of mid-tarsi. Presegmental plates present on segments 3–7 or 3–8, postsegmental plates on segments 3–4. Gills present on segments 1–7 or 2–8. Anal rods uniformly broad, long, with blunt or forked end.

Pupa lying in a loose cocoon; case cavelike, made of small stones or large sand grains.

Mode of life and habitats. Brooks, rivulets and rivers of various types, including large rivers in the plains.

Distribution. European and Asian parts of the USSR. In addition, cosmopolitan.

### Key to Genera of Hydropsychidae

Full-grown larva

1 (2). Medium sized (12–14 mm) or larger, 18–20 mm long. Head dorsally with a characteristic dark lyre-shaped figure and with large, light spots arranged in a different manner . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. **Hydropsyche** Pict. (p. 547)

2 (1). Length 10–11 mm. Pattern present on the dark, or slightly dark, background of head; pattern consisting of small, light spots . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. **Cheumatopsyche** Wall. (p. 581)

Pupa

1 (2). Length 9–14 mm; 4th segment of maxillary palps longer than segments 2 and 3; postsegmental plates of abdominal segment 3 transverse . . . . . . . . . . . . . . . . . . . . 1. **Hydropsyche** Pict. (p. 547)

2 (1). Length 6–7 mm; 4th segment of maxillary palps shorter than segments 2 and 3; postsegmental plates of abdominal segment 3 rounded . . . . . . . . . . . . . . . . 2. **Cheumatopsyche** Wall. (p. 581)

## 1. Genus Hydropsyche Pictet

**Full-grown larva.** Length 15–20 mm. Head dorsally with a dark lyre-shaped figure, with or without a pattern of light spots. Left mandible with a penicillus in the middle. Posterior margin of mesonotum with a large curved black spot in the middle; metanotum with a large spot. Four anal gills. Anal legs posteriorly with a tuft of black, strong setae.

**Pupa.** Length 8–14 mm. Antennae almost reaching end of body or slightly longer. Mandibles finely serrated, with several large denticles. Postsegmental plates of abdminal segment 3 with 2 rows of small, anteriorly-directed denticles. Anal rods divided into 2 small lobes posteriorly.

Mode of life and habitats. Running water of various types; living on the bottom or on wood.

Distribution. Throughout the European and Asian parts of the USSR. In addition, Europe, North America, Asia; genus little represented in Africa and Australia.

### Key to Species

### Full-grown larva

1 (2). Frontoclypeus mainly light, milk-white on the background of the lyre-shaped figure; light background sometimes constricted in the middle; length 14–15 mm ...... 1. **H. ornatula** McL. (p. 548)

480 2 (1). Head completely dark dorsally, or with a pattern of light spots which are sometimes indistinct.

3 (4). Length 14–15 mm; closely related to H. ornatula; frontoclypeus dark, divided into an anterior and posterior spot which are not always distinct; sometimes with 3–4 spots ................................................ 2. **H. guttata** Pict. (p. 559)

4 (3). Length 18–20 mm. Head with distinct but very variable pattern; 4–9 light spots on the dark head.

5 (12). Not more than 5 light spots on dark figure of head.

6 (7). Dots of lateral sclerites of head dark and distinct; median spot on mesonotum large; anterior margin straight in the middle, forming an obtuse angle laterally; large distinct, dark dots anterior to the spot and in its lateral arcs; length 16–17 mm .................................... 6. **H. instabilis** Curt. (p. 572)

7 (6). Dots of lateral sclerites of head less dark or pale.

8 (9). Anterior margin of median black spot of mesonotum straight; dots lateral to spot small; length 18–20 mm ............................................ 5. **H. saxonica** McL. (p. 571)

9 (8). Anterior margin of median black spot curved.

10 (11). Large dots near median spot at posterior margin of mesonotum absent; median spot of metanotum small; its posterior margin almost straight, without serration or with only 1 or 2 serrations ........................... 3. **H. angustipennis** Curt. (p. 559)

11 (10). Large dots near median spot at posterior margin of mesonotum indistinct and pale; spot of metanotum slightly larger; posterior margin with numerous serrations . . . 4. **H. pellucidula** Curt. (p. 568)

12 (5). Pattern of dorsal surface of head complicated; frontoclypeus sometimes with 7–9 light spots . . . . . . . **7. H. nevae** Kol. (p. 573)

1. **Hydropsyche ornatula** McLachlan

Döhler, 1911:385–390, Figures 1–8. — Lepneva, 1929:600–602, Figure 1; 1940:206–207, Figure 154, 2–3; 1960b:19–24, Figures 1–12.

**Full-grown larva.** Length 12–15 mm. Head broad (Figure 678, A); length to width 1:9.0. Frontoclypeus with shallow lateral indentations; its anterior margin slightly projecting, crenulate. Clypangulus small, blackish brown. Gula fused with pregula, wedged in a small triangle into the head capsule; anterior margin of pregula projecting; its angles slightly raised. Postgula forming a small, black sclerite. Frontoclypeus mainly light; grayish brown stripes along the frontal sutures, which form a dark lyre-shaped figure together with the dorsal stripes; sides of head light, without dots. A broad dark stripe ventrally in the middle of each half; head dark ventrally, with indistinct light dots near the occipital foramen (Figure 678, B). Dark dots absent.

A characteristic covering of cylindrical, sausage-shaped setae, which are more or less long dorsally, mainly in the dark areas, or near them (Figure 679); smaller, hairlike setae which are either simple, divided or have 2 or 3–5 branches among them; Dorsal stripes completely covered with these two types of setae; dark stripes of frontoclypeus near seta 9 and near the bifurcation of the frontal sutures also with the two aforementioned types of chetae; stripes only with small covering hairlike setae in some places; these are rarely present also on the white "mirror" of the sclerite. A group of long sausage-shaped setae near base of mandibles; light sides of head also with covering setae of the two types behind the eyes; these setae are sparser. Ventral surface without covering setae.

Anterior-margin, primary setae situated near the angles of the frontoclypeus; median seta transparent, straight and strong; intermediate seta relatively long, light yellow; lateral seta shorter and paler; frontal setae light, thin and short; anterior frontal seta situated in a group of similar secondary light setae on the anterior angle; median frontal seta situated near the tentorial pit; posterior frontal seta situated near the frontal suture, posterior to the pit. Seta 9 longer and darker than the others, reddish brown; the short, thin seta 11 situated posterior to it; seta 7 light, as long as intermediate anterior-margin seta; ventral seta 8 slightly yellowish, slightly shorter; seta 10 situated posterior to seta 7, thin and small; seta 12 situated on the outer side behind the eye; seta 14 situated more medially, also thin; seta 16 thin and short; seta 17 smaller, situated posterior to seta 16, near the suture; ventral seta 18 small, light yellow, spinelike. Dorsal stripes anterior to the eyes with a group of thin, light, secondary
481 setae which are smaller and sparser on the clypangulus; several light, short, secondary setae on sides of the head.

Labrum (Figure 680) rounded anteriorly, without median indentation; posterior-angle sclerites thin, curved inward, with a large brownish yellow spot at the base; sclerite brownish yellow in the middle, whitish laterally and posteriorly; median pit asymmetrical. Seta 5 yellowish, straight, relatively long; all other setae indistinguishable among the numerous covering setae on the dark anterior-median part of the sclerite. Hairs of anterior-angle penicillus finely pectinate at the end.

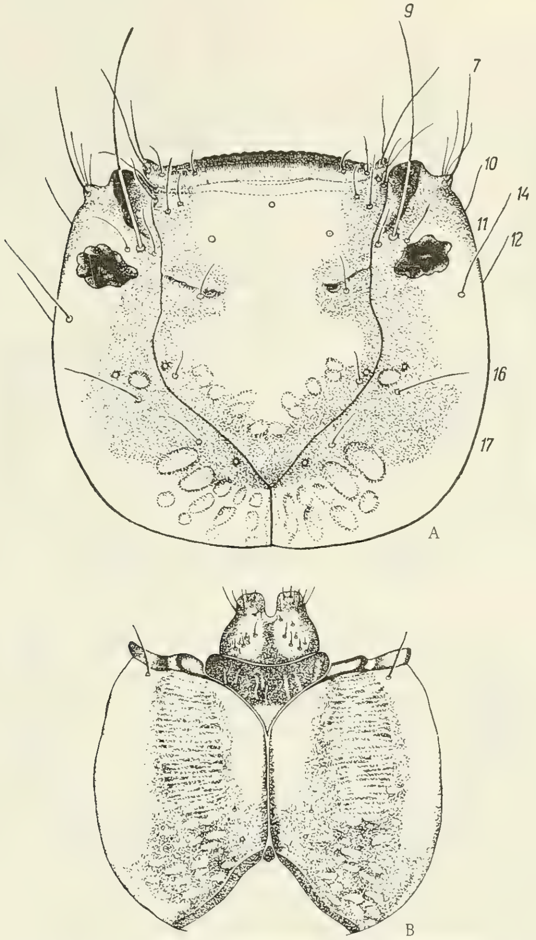


FIGURE 678. Hydropsyche ornatula McL. Head, dorsal (A) and ventral (B). Secondary setae not all shown

Mandibles (Figure 681) without transverse suture, reddish brown apically.
Left mandible with 2 apical teeth; lower blade with 4 teeth, 3 of which are
long and situated in the apical part and 1 broad, rounded and situated further
482 basally; a median brush near the latter tooth. Right mandible with a
characteristic ledge and a bend at the base of the apical part; apical part
with 2 teeth at the end; lower blade with 2 large teeth and a small tooth
between them; a large, rounded tooth characteristic for the Hydropsychinae

further basally. Outer side of mandibles with 12—14 light setae mainly in the basal part, 2 primary setae among them.

Submentum (Figure 678, B) lighter than pregula, chestnut brown, darker on the outer side; setae brown; primary seta longer than the others, situated near an indentation of the lateral margin, near the base of the lobe; cardo yellowish; setae brown at base and partly on the sides; stipes pale yellow, with a narrow yellowish brown stripe; setae chestnut brown and light brown, forming 2 tufts near base and apex. Palpifer yellowish; primary distal seta relatively thick, brownish, straight, reaching 2nd segment of palp; 2nd primary seta situated basally near the median angle, spinelike, small, light; numerous thin, light hairs near the inner margin; galea cylindrical; sensillae and setae relatively large. Submentum reddish brown; ventral sclerites small, rounded, their setae light; relatively large; palpifer small, horseshoe-shaped, light yellow; labial palps very small.

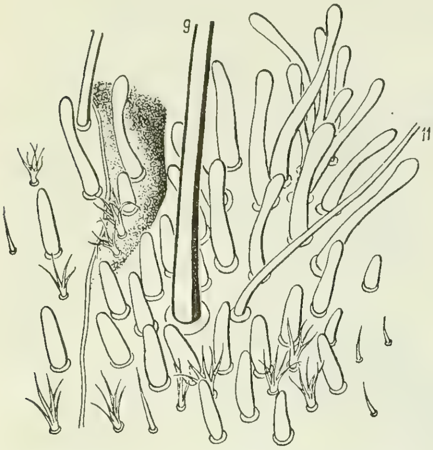
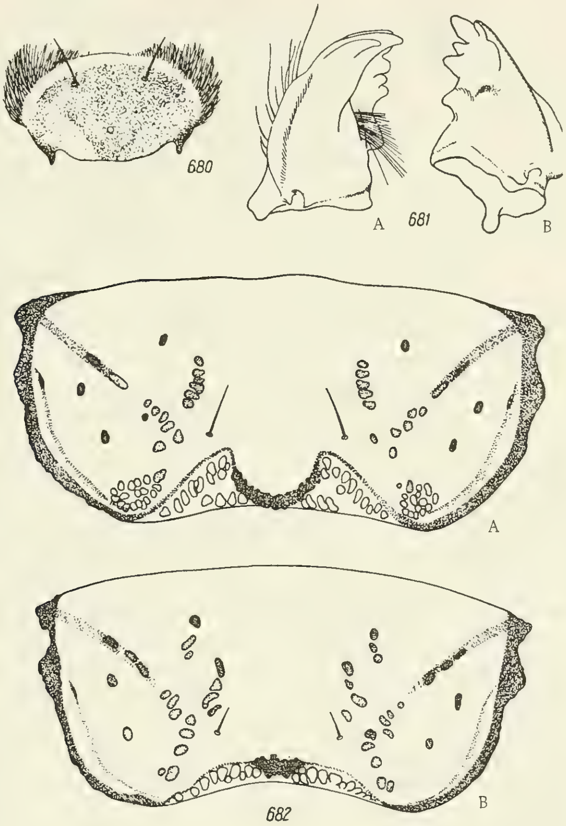


FIGURE 679. Hydropsyche ornatula McL. Secondary covering setae in area of primary setae 9 and 11

Pronotum mainly brown in the middle, whitish and without pattern laterally, except at the anterior margin; large spots characteristic for Hydropsyche, light and in each half of the sclerite; lateral margin with a black border broader near the posterior angles; posterior angle narrow, chestnut brown laterally, light in the middle of each half; anterior margin without dark border. Sclerite with the same sausage-shaped covering setae as on the head; small hairlike setae among them mainly simple, with 2 or several branches in some places; sparse yellowish sausage-shaped covering setae on the whitish lateral part anteriorly; only isolated setuliform and hairlike setae posteriorly. A regular row of sausage-shaped chetae, long laterally at the anterior margin; short, dark, inward-curved setae with blunt ends near the anterior angles; hairlike setae divided from the base into thin, very long, light setae are among the sausage-shaped setae; a short, light, ordinary seta near the anterior angle, among the minute anterior-margin setae; a longer, thicker, brownish seta with a blunt end which is a modified sausage-shaped seta near the anterior margin; a similar, brownish, longer seta with blunt end present instead of the medioanal seta in the posterior third; sclerite with several short, light, ordinary setae resembling the anterior-angle seta; one of them near the median suture, in about the middle of the sclerite; 3 other setae form a transverse row; a shorter seta in the anterior third, in the dark area anterior to the latter setae and closer to the anterior margin; a similar seta in the light area of the sclerite.

Meso- and metanotum (Figure 682) without pattern, except for the oblique dark stripes near the anterior angles; they are mainly brown and light posteriorly; anterior margin pale; lateral margin with a narrow, black border

which extends to the sides of the posterior margin. Median black, posterior spot of mesonotum with concave anterior margin, without dark dots anteriorly and laterally; small spot of metanotum with irregular anterior margin, with a deep indentation posteriorly. Medioanal surface
483 seta of mesonotum longer than that of pronotum, brownish, with blunt apex; medioanal seta of metanotum short.



FIGURES 680–682. Hydropsyche ornatula McL.:

680 – labrum; 681 – mandibles, dorsal: left mandible (A), right mandible (B); 682 – mesonotum (A), metanotum (B).

Propleuron (Figure 683) whitish yellow at the base, irregularly quadrangular; pleural suture diagonal, blackish brown; episternum larger than epimeron, with indistinct, light, large dots; epimeron with a group of short setae in the basal part; 3 setae thicker than the others, and 2 small distal setae; trochantin with a hornlike process at the base so that it appears forked; process without setae; other part of sclerite with several short setae, 2 of them thicker than the others; 2 setules situated distally.

Pleuron of meso- and metathorax consisting of a small brown sclerite with a blackish brown suture and with small, light spots with a brown border near the base; trochantin forming a yellowish triangular sclerite contiguous with the episternum; this plate has a narrow, reddish brown border at the basal and posterior margin; a small, stout, dark seta near the distal end of the border; both setules whitish, anteriorly to light part of the sclerite.

484 Prothoracic sternite (Figure 684) light; anterior margin narrow, reddish brown; a broad, transverse, dark brown stripe in the posterior part.

Mesothorax ventrally with a gill with 2-segmented stalk; 1st segment of style with 8 filaments, 2nd segment with 8 or 9 filaments. Metathorax with 2 ventral gills with 2-segmented stalk; lateral gill longer, its basal segment with 8 or 9 filaments; apical segment with 7 or 8 filaments; basal segment of median gill with 3 filaments, apical segment with 6 or 7 filaments.

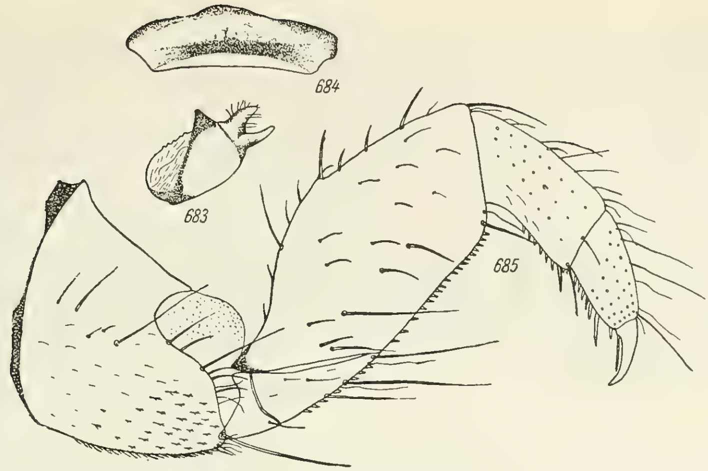
Forelegs (Figure 685) prehensile, slightly shorter but more massive than midlegs and hind legs; ratio of length of legs 86:100:112. Forelegs brownish yellow, midlegs and hind legs yellow, without stripes or dots; their ends with dark border or spots in some places.

Fore coxa shorter but higher than mid- and hind coxa; distodorsal depression shallow, not reaching middle of segment; dorsal surface slightly concave posteriorly; anterior margin forming a crest with a small basal tubercle; crest with a number of short, dark setae (not at the margin of the depression); primary basal seta situated a short distance from the tubercle, relatively long, strong, dark brown; a primary posterior seta, which is slightly shorter posteriorly, near the margin of the depression; 2 short, dark setae further basally; 1 or 2 strong, brown setae and several small, light setae further apically, at the margin of the depression, anterior surface with 2 short, yellowish setae (anterior primary setae?) and several smaller, light setae; minute covering chetae numerous in distal part of anterior surface; interspersed with several, flat, divided setae; setae of ventral surface small, sparse; posterior distoventral seta dark brown, relatively long, much longer than the small, strong, anterior seta; small,thin, light setae between them.

Trochanter not closed; anterior primary seta distinct; 2 setae posteriorly, a short seta situated in the middle and a long seta subventrally; setae of anterior surface of trochanter including apical part of basal segment in form of small covering spinules which are longer ventrally; ventral side with numerous long, light setae, and 3 brownish, long, primary setae; a crest of light spinules posteriorly and ventrally.

Anterior surface of femur convex, posterior surface concave; dorsal surface relatively broad, with a sharp anterior margin; an angle and small tubercle in the middle of this margin. Primary basodorsal seta situated at base of tubercle, directed anteriorly; distodorsal seta displaced to the posterior margin; secondary dorsal setae mainly thin, sparse, light and small. A longitudinal group of setae inclined to the ventral side anteriorly and subdorsally; dark brown, spinelike setae predominate among them;
485 ventral setae similar but longer, denser in the middle; a row of small, light spinules posterior to them, along the crest; basodorsal, subdorsal and ventral setae form a large brush (Lepneva, 1960:23, Figure 10); 3 long, light setae in the middle of the posterior surface form a longitudinal row; the basal of these setae light brown, longer and thicker than the other two; several small or very small setae more basally and dorsally; primary posterior seta situated subventrally, strong, dark, long; a thin secondary seta near it.

(484)



FIGURES 683–685. Hydropsyche ornatula McL.:

683 – propleuron; 684 – prothoracic sternite; 685 – right foreleg, posterior.

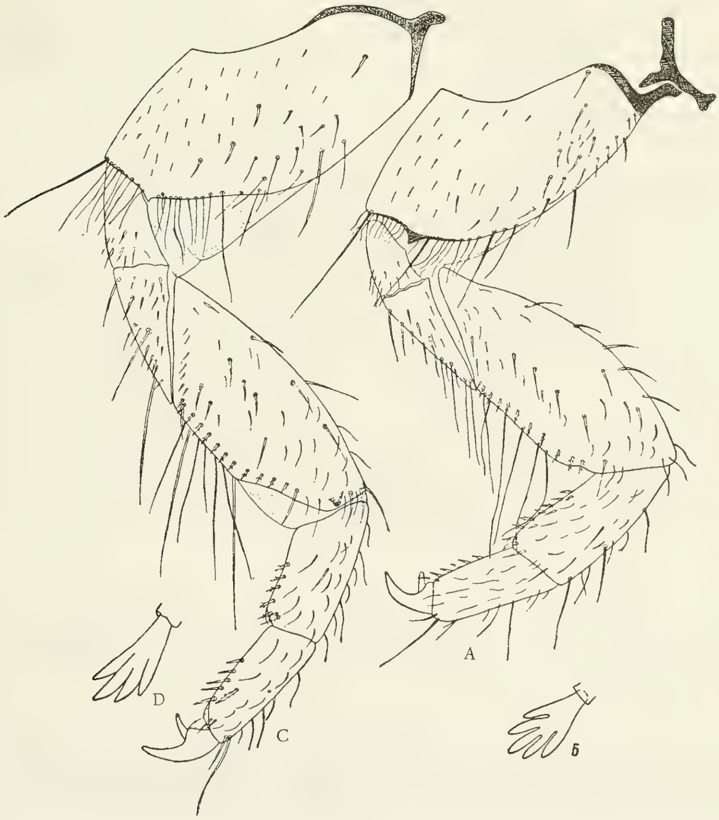


FIGURE 686. Hydropsyche ornatula McL. Left midleg, anterior (A), seta of subventral anterior row of femur of midleg (B), left hind leg, anterior (C), seta of subventral anterior row of hind femur (D)

Tibia slightly longer than tarsus, its dorsal side with sparse, small, thin, light setae, of which 3 are yellowish, thicker and longer than the others; primary setae indistinguishable among the secondary setae; sparse setae situated in the middle of the segment anteriorly and subdorsally; a row of 4 long spinelike setae, which are thicker apically subventrally; 2 small setae more basally; primary, subventral, posterior seta relatively long; ventral comb of tibia consisting of small, light, spinelike setae; 2 light primary distoventral setae.

Tarsus narrower apically; light dorsal setae more numerous than on the 486 tibia; among them several thicker, yellowish setae; a row of 5 long spinelike setae anteriorly and subventrally; setae of ventral comb in form of large light spines; subapical spine larger than the others; margin has a short, blunt spinule distally.

Claw dark, curved, with a light basal seta adpressed to the surface.

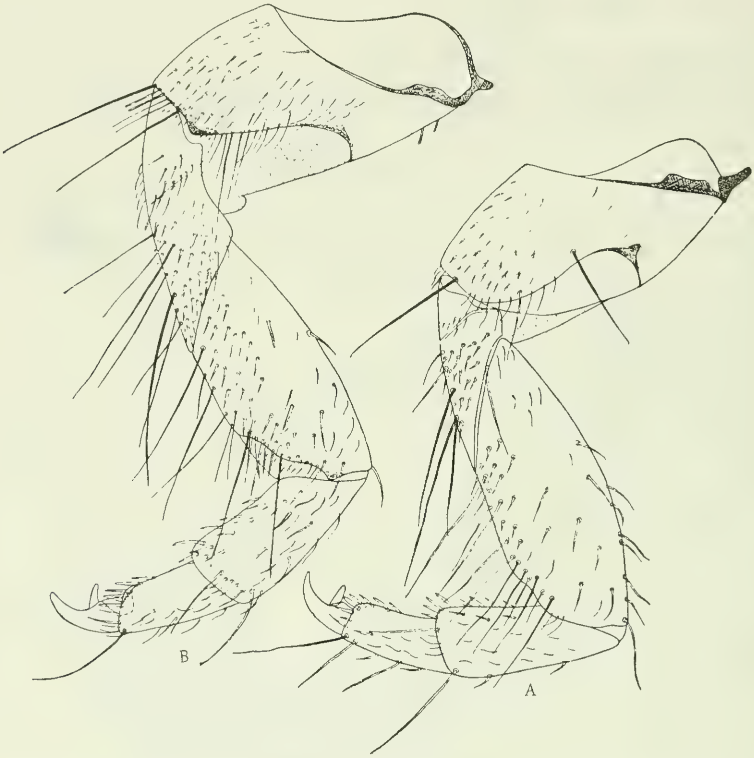


FIGURE 687. Hydropsyche ornatula McL. Right midleg, posterior (A), right hind leg, posterior (B)

Mid-coxa and hind coxa moderately long (Figures 686 and 687); distodorsal indentation extending slightly beyond middle of segment; dorsal surface convex anteriorly, slightly concave posteriorly; dorsal groove hardly marked;

a row of short setae at the anterior margin of the dorsodistal indentation, 2 of them thicker and longer (primary setae?); minute covering chetae, which are pointed or blunt, and thin, small, and several short, yellowish spinelike setae at the anterior margin; short setae and 1 or 2 thicker and longer setae at the posterior margin of the distal indentation, except in its basal third; further basally, near the margin of the indentation, stands the posterior, primary seta, which is dark brown and long on midleg and foreleg, and short on the hind legs. Anterior surface of coxa with thin, small, covering chetae; a few larger, brownish setae among them on the subdorsal side; covering chetae larger on the posterior surface; interspersed with several small, branched, thick setae in the distal part of the midlegs; ventral side with only small, sparse covering setae; both distoventral setae long; anterior seta slightly longer than posterior seta; short, light setae among them and laterally.

487 Anterior and posterior surface of trochanter, including apical part of basal segment, with small spinelike setae which are more numerous and massive posteriorly; they are small on the basal segment; posterior, primary seta situated subdorsally, well marked; ventral side with covering chetae; they are slightly larger on the 1st segment, long, transparent, setuliform, with a thick base on the 2nd segment; several thicker, brownish, long setae among them.

Dorsal surface of femur uniformly convex; ventral margin almost straight; dorsal side with short, light setae including the primary, basodorsal seta, the distodorsal seta, which is longer than the others, and displaced to the posterior margin; a row of small, light, spinelike setae anteriorly; isolated, small setae more dorsally; primary anterior seta spinelike, situated subventrally near the apex; setae of posterior surface numerous, mainly subventrally; primary posterior seta situated distally, relatively long; anterior side with a row of short, thick, divided spinelike setae; a few long setae and several dark brown, thicker setae (including 2 primary setae) posteriorly.

Tibia of midleg and hind legs slightly longer than tarsus; thin light setae dorsally; a long, yellowish seta distally and dorsally; small setae anteriorly and posteriorly; primary posterior seta situated subventrally, brown,-long, $^3/_4$ as long as the tarsus; ventral side with a row of strong, small spines which are longer apically; hind legs with 4-branched setae anterior to them; 3 similar setae situated subventrally, near the apex.

Tarsus with similar light setae as on the tibia, and with a strong, relatively long, dark brown distodorsal seta; anterior and posterior surface with sparse, small setae; a row of spinules ventrally; posterior surface of midlegs with 2 massive spines; posterior surface of hind legs with 3 massive spines.

Claw dark, curved; basal seta forming a short, massive, blunt spine.

Abdomen uniformly broad on the first 5 segments, tapering on the 3 following segments; dorsal surface of segment 8 more developed than ventral surface; segment 9 very narrow. Ventral gills present on segments 1—7; pleural gills present on segments 3—7; ventral outer gills with 2 branches; median gills with 1 branch; stalks of gills indistinctly 2-segmented or 3-segmented.

Stalk of pleural gills modified into a short, muscular, flattened appendage which acts as organ of movement, ensuring a current in the chambers inhabited by the larvae; number of gill filaments 1 or 2, or filaments absent at the apex.

Arrangement of gills and number of gill filaments shown in Table 15.

TABLE 15

| Segment | Pleural | Ventral | |
|---|---|---|---|
| | | lateral | median |
| 1 | – | 15–17+15–17 | – |
| 2 | – | 20–21+17–18 | 13–14 |
| 3 | 1 | 18–19+17–18 | 15–16 |
| 4 | 1<br>2 | 14–15+16–17 | 11–12 |
| 5 | 1<br>2 | 16–17+17–19 | 11–12 |
| 6 | 1<br>2 | 10–11+10–12 | 8–9 |
| 7 | 1 | 8–10+10–11 | – |

Abdomen with a continuous cover of long, sausage-shaped, small, slightly curved chetae interspersed with a few cup-shaped chetae which are narrower at the base.

Primary setae of abdomen light and thin; anterior-margin seta small; anterior-angle seta short; a smaller secondary seta near it; medioanal seta longer than the others; intermediate and lateral seta situated close together nearby; they are thin and slightly shorter. Anal setae on the posterior segments (6–8) slightly longer than on the preceding segments. Ventral 488 side of segment 8 with 2 thin, triangular yellowish plates with shining yellowish brown, long, covering setae; each side with 6 strong, dark brown setae posterior to the plate, the 3 lateral setae larger than the others. Ventral sclerites of segment 9 large (Figure 688, A); covering chetae similar, long, setuliform, shining brownish yellow, thick, long, pointed; 8 brown thick setae posteriorly, the 2 lateral setae larger than the others. Sides of segment 9 with a strong, dark brown, longer seta, and 4 short, thick setae. Segment 9 dorsally with 2 thin, triangular, yellowish brown sclerotized areas with strong setae; posterior part of sclerite with 3 brown setae, the lateral seta longer than the other 2; near it, 2 thin, hairlike setae. Covering setae of segment 9 all hairlike; cup-shaped covering setae are absent.

Anal legs relatively long (Figure 688, B), geniculate; dorsolateral sclerite light yellow, with a reddish brown stripe at the base on the outer side; 2 dark brown, long setae, a moderately long, light seta, and a very thin, short seta dorsally near the base of the articular rods; similar dark brown, shorter, sparse setae situated in the distal half at the ventral margin; several such setae more dorsally; margin and surface also with several sparse, thin, light setae. Covering chetae of sclerite as on the other sclerites, curved, blunt and hairlike. Membranous surface ventrally with a long, strong seta directed to the end of the claw, and with several light setae; apical part without setae, in the middle basal part with short, sparse, light setae; 2 chestnut brown articular rods dorsally and distally; a similar chestnut brown plate with a vertical fan of long, golden brown, straight setae on the inner side.

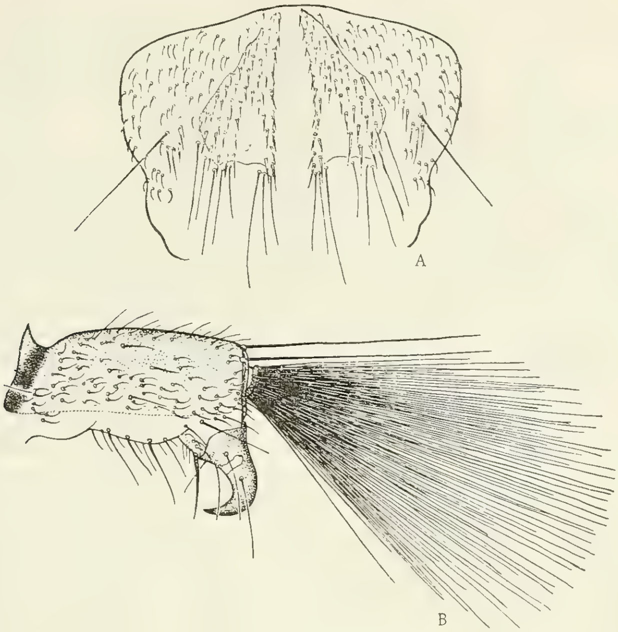


FIGURE 688. Hydropsyche ornatula McL. Segment 9, ventral (A), left anal leg, outer view (B)

Sclerite "c" large, golden brown, with a strong, thin, dark brown seta crossing end of claw; several light, needle-shaped setae ventrally near this seta.

489 Claw dark brown, bent at a right angle, with a narrow, membranous, transverse stripe. Setae 1, 2, 3 and 6 relatively long, light yellow; seta 5 situated on the outer side in the basal part, thin, straight and short; seta 4 situated medially, near the membranous stripe, small and light; setae 7 and 8 curved, light and long.

**Pupa.** Length of male pupae 8.1—8.5 mm, of female pupae 9.0—9.2 mm. Antennae filiform, reaching posterior end of body in male pupae, where their ends are curved upward; they are shorter in female pupae, not reaching end of body; antennal segments longer than wide; 1st segment wider than the others; dorsal side with 3 long setae; ventral side with 3 small setae.

Anteclypeus bordered with shallow folds; its projecting lateral part with 4 long, brown setae and a group of short setae.

Labrum narrower than clypeus; a small anterior part of labrum without setae in the middle; numerous brown setae laterally; similar and longer setae in 2 large groups divided by a narrow median stripe with a few setae posteriorly; 3 thicker and longer primary setae in each group; setae near posterior margin of labrum absent. Setae of labrum, clypeus, frons and pre frontal region projecting above the dorsal surface in a dense, anteriorly-directed brush which is used to clean the openings at the anterior end of the case.

Mandibles with massive, broad, basal part and long geniculate apical part; blade of right mandible with 3 large teeth; blade of left mandible with 2 large and 2 small teeth; 2 very small, blunt denticles near the apex; a group of short, brown setae near the base on the ventral outer side; both primary, outer setae are short, situated close together, in about the middle of the mandible; 2 or 3 small thin setae near them.

Sheaths of forewings reaching end of abdominal segment 6 or beginning of segment 7. Midlegs natatorial; setae on segments 1—3 dense, those on segment 4 sparse. Presegmental plates present on segments 3—8, postsegmental plates on segments 3—4; presegmental plates small, spoon-shaped; denticles dark brown and large; postsegmental plates broad; plate of segment 3 elliptical, concave, with numerous small denticles at the margin; plate of segment 4 half elliptical, with straight anterior margin; sparse, large, blunt denticles present at the posterior, curved margin; number of denticles as follows: III:7+52; IV:3+11—12; V:4—6; VI:5—6; VII:5; VIII:3.

Gills pleural and ventral. Pleural gills situated on massive teat-shaped pointed bases on segments 3—7; segments 3 and 7 with a small gill posteriorly; other segments with 3 gills in a longitudinal row behind each other; middle gill thinner and shorter than anterior and posterior gill; ventral gills situated near anterior margin of segments 2—7, with 1 or 2 branches which are contiguous at the base; the branches appear 3-segmented, because of the whorled arrangement of the filaments and the tapering of the stalk; filaments numerous, light and long. Number of gills shown in Table 16 (which gives the number of stalks and not of the filaments).

TABLE 16

| Segment | Pleural | Ventral |
|---|---|---|
| 2 | – | 2 |
| 3 | 1 | 2 |
| 4 | 3 | 2 |
| 5 | 3 | 2 |
| 6 | 3 | 2 |
| 7 | 1 | 1 |

Anal rods broad, with raised apex, forming 2 pointed posterior processes of different length, so that the rod appears forked; median process larger, lateral process smaller; outer side with 7 long, strong, dark brown setae; a row of short setae to the base of the rod; several short, strong setae ventrally, near the end of the rod; median seta thicker than the others; posterior part with 9 thin, light brown setae dorsally.

Genital appendages well marked. Genital appendages broad, bracket-shaped in young male pupae; both segments indistinct in old male pupae; penis sheath long, with a thick, divided end. Genital appendages of female pupae consist of 2 broad, contiguous lobes.

Pupal case 10–10.2 mm long, made of minute sand grains; its ends rounded, and there are small openings on the case; a narrow slit which is open or slightly covered with tissue ventrally; this slit is sometimes absent.
490 Walls of the case covered with detritus particles, which are sometimes large, consisting of fragments of stalks; case attached to substrate with a few filaments at the anterior and posterior end, and laterally (but not at the margin of the narrow slit); case sometimes attached to a small stone which forms its ventral wall, covering the ventral slit. Cases sometimes attached in rows or groups in large numbers, on top of each other.

Mode of life and habitats. Larvae predacious, building capturing chambers with a net of regular quadrangular meshes across the current or at an angle to the current; the larvae feed on plankton and small benthic animals which fall into the net. They live in large rivers, in the plains, throughout the riverbed, on the solid ground, often on large pieces of wood; they fly in large numbers; recorded from the Dnieper, Volga, Oka, Kama and other rivers.

Distribution. European USSR, including the Caucasus, Western Siberia, rare in Eastern Siberia. In addition, Europe, Iran, North Africa.

### 2. Hydropsyche guttata Pictet*

Lepneva, 1929:600–602, Figure 2.

**Full-grown larva.** Closely related to H. ornatula; differing in the pattern on the head. Frontoclypeus with a dark band with a short posterior median process and a longer anterior process which is divided at the end; lateral branches of process contiguous with the dark border of the sclerite in some forms, so that there are 3 light spots in the anterior part; 4th spot situated posterior to the band. Spots small in dark larvae, sometimes indistinct, or the whole frontoclypeus dark. This is also rarely the case in the dark variety of Hydropsyche ornatula.

Mode of life and habitats. It occurs in the same places as H. ornatula, usually in smaller numbers.

Distribution. European USSR. In addition, Europe, Iran.

### 3. Hydropsyche angustipennis Curtis

Klapálek, 1888:48, Figure 17. — Ulmer, 1903:115. — Siltala, 1905:103–107, Figure 23; 1907:413–427, 625, Plate 15, Figure 7, j, k, n. — Ulmer, 1909:236, 300, Figures 362, a; 438, a. — Lestage, 1921:535–543, Figure 179, a, 181, 182. — Brindle, 1960d:267–270, Figures 1–9.

**Larva.** Length 17–18 mm (Figure 689). Head mainly yellowish; pattern smoke brown or dark brown. Frontoclyepus (Figure 690) less broad posteriorly than in H. ornatula, with shallow lateral indentations; tentorial
491 pits reddish, small; anterior margin finely crenulate, with a row of fine divided chetae near the margin. Sclerite with 4 light, yellow spots on the

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* The larva from the Elbe described as H. guttata Pict. (Döhler, 1911) is that of H. ornatula McL. (see Bening, 1924:287; Lepneva, 1929:600–601).

dark background: 3 spots anteriorly and 1 posteriorly, posterior spot and medioanterior spot usually indistinct; dark background laterally with a row of 4 small dots near the anterior margin; posterior part in the posterior angle and laterally with light dots which are more distinct in dark specimens. Lateroanterior margin seta transparent, curved inward, short, situated in the angle; intermediate seta relatively long, straight, dark brown, situated near lateral seta; median seta small, dark, situated at a distance from the other 2. Frontal setae small; anterior frontal seta situated in the anterior angle, among the secondary setae; median frontal seta situated medial to the tentorial pit. Covering setae yellowish brown or yellow, setuliform, situated on the dark lateral stripes; covering setae on the light spots less numerous, absent in some places; anterior-angle group with several thicker, blunt setae. Clypangulus small, with a narrow, lateral, dark stripe with several small ordinary covering setae. Dorsal stripes chestnut brown, broader behind the eyes, converging near the coronal suture; a more or less distinct dark stripe along the suture; groups of light brown dots on the dark stripes along the frontal sutures and posterior to the eye; ventral surface and sides of head mainly light; a wide, dark brown area with large, more or less light dots lateral to the gular suture; one of these spots bears the short, spinelike, light, seta 18. Dorsal surface with seta 9, which is dark brown and longer than the other setae of the head; seta 11 situated nearby on the outer side thin, small and light brown; seta 7 situated near the anterior margin, shorter and thinner than seta 9; ventral seta 8 similar to seta 7, slightly smaller; seta 10 light, small, situated anterior to the eye; the large, brown seta 14 and the smaller seta 12 situated behind the eye; seta 15 thin, light brown and short; seta 16 longer, situated near the suture. Dorsal stripes with covering setae similar to those on the frontoclypeus; similar, sparser and thinner setae on the light sides of the head; sausage-shaped, blunt setae among them in some places.

(490)

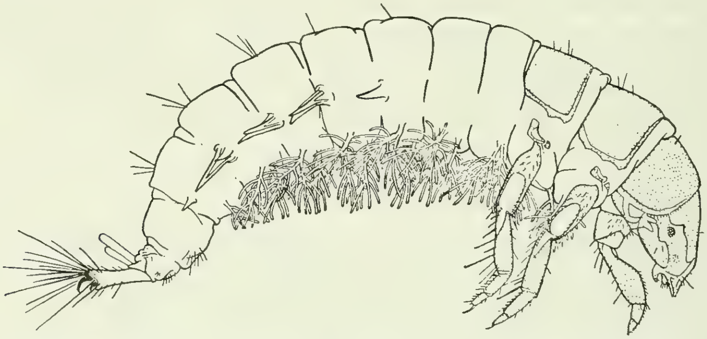
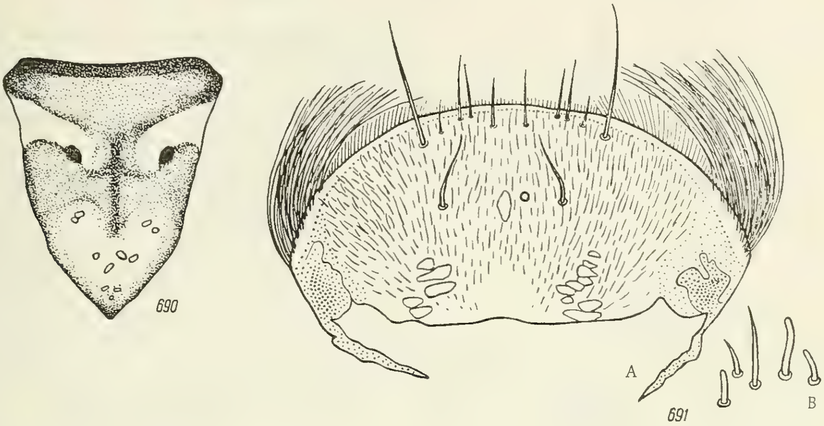


FIGURE 689. Hydropsyche angustipennis Curt. Larva (young prepupa) lateral (after Haller)

Labrum (Figure 691) shorter and broader than in H. ornatula McL.; dorsal surface darker, reddish brown, covered with fine chetae; spots near the posterior angles shining dark reddish brown; posterior-angle sclerites thin and brown; distinct grayish brown spots on the dark background laterally near the posterior margin, a similar spot near the median pit.

Covering setae mostly dark, blunt, relatively long, interspersed anteriorly with brown, setuliform, pointed spinules and small, light, hairlike spinules; membranous margin with long inward-curved tufts of grayish brown, strong hairs arranged in fans near the angles. Seta 5 light brown, straight, directed anteriorly; the short, transparent seta 4 situated more medially, 492 near the margin; 3 straight, thin, transparent setae at the margin, the lateral of these setae very small.

(491)



FIGURES 690 and 691. Hydropsyche angustipennis Curt.:

690 — frontoclypeus (after Siltala); 691 — labrum, dorsal (A), covering setae (B).

Both mandibles (see Figure 89) with 2 apical teeth; upper blade of left mandible without teeth, lower blade with 4 teeth; basal tooth blunt and broad, the other 3 teeth of the left mandible of the same size; tooth near the basal tooth on the right mandible projecting and much longer than the others; chetoids of median brush of left mandible straight, thin, relatively long; outer surface of mandibles with dark brown, marginal ridges, setae on the surface light, mainly short; both primary setae situated in about the middle, moderately long, one near the dorsal ridge, the other slightly posteriorly.

Submentum yellowish, with a dark median stripe; lobes dark brown; 6 setae of the oblique basal row dark, strong, 2 of these longer than the others; several small dark, light setae near the row; surface setae of lobes brown, and both short and relatively long; lateral primary seta near the base longer than the others. Cardo golden brown; 20—22 setae at base and on outer side brown, the primary seta situated among them; stipes with a reddish brown, longitudinal, dark stripe; tufts of setae, including a primary seta on the outer side distally and basally. Palpifer and palps light brown; apical seta of palpifer grayish, relatively thick, straight; mediobasal seta very small, transparent, light, situated near the base; galea adpressed to palp, dark brown with long setae and sensillae. First segment of palp twice as long as the 2 following segments; last segment narrower, longer than the preceding segment, with short sensillae. Mentum light yellow, dark brown laterally; ventral sclerites small, light, round, with a transparent seta; horseshoe-shaped sclerite of labial palpifer yellow; palps very small, situated lateral to the large opening of the spinning glands.

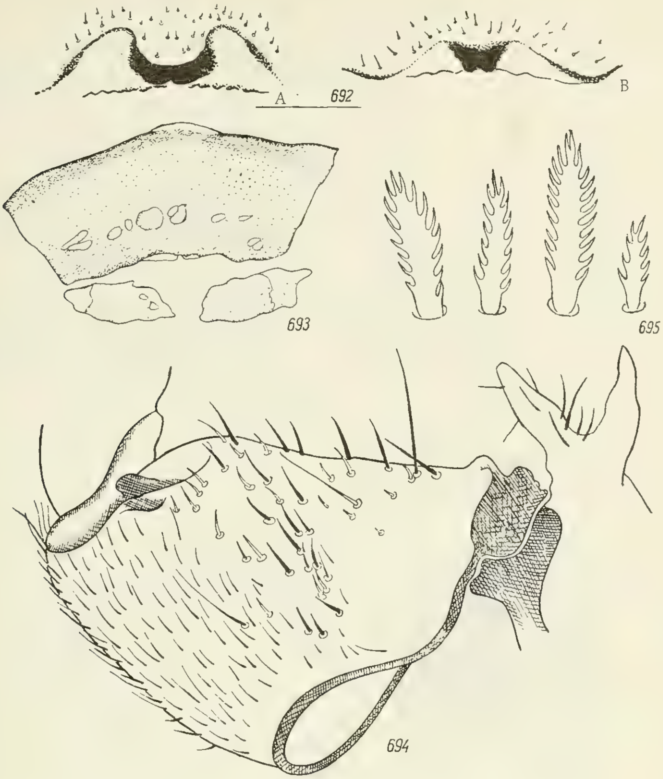
Pronotum mainly yellowish brown, darker in the middle, lighter laterally (at the place of the spots); spots indistinct; anterior margin narrowly brown; lateral margin broadly blackish brown; posterior margin brownish black in the middle and near the angles, brown in the middle of each half; a dense row of this yellowish hair near the anterior margin; surface covering setae setuliform or cylindrical, blunt; latter numerous anteriorly; 4 or 5 of them near the anterior angles curved and longer than the others; among them a long brown anterior-angle primary seta; medioanal seta brown, moderately long.

Meso- and metanotum yellow or yellowish brown, slightly darker in the middle; an oblique brownish stripe with coarse dots, which are pale posteriorly from the anterior angle; a curved row of grayish brown dots medial to this stripe; 2 large dark dots on its outer side. Anterior margin of sclerites without border in the middle, or with a pale border which is brownish laterally; border of angles dark brown. Lateral margin and posterior angles with broad black or brownish black border. Black curved spot in middle of posterior margin of mesonotum with concave anterior margin; groups of pale, coarse dots anterior to the median spot (Figure 692). Median spot of posterior margin of metanotum small, without or with 1 serration posteriorly; posterior margin narrow, light brown or indistinct lateral to the spot. Setae of sclerites primary and secondary, brownish, yellowish or light; surface setae situated near the posterior margin of the oblique stripe; primary medioanal seta brownish, moderately long; a small, thin, light secondary seta near it; intermediate and lateroanal setae situated on the other side of the group of dots, yellowish, thin, short; a short, light seta posteriorly near the lateral margin. A group of 3 setae laterally, near the anterior margin; 2 small setae slightly posteriorly and closer to the median line; 2 setae near the oblique row and 1 seta on the outer side.

Outer basal bifurcation of trochantin (Figure 694) slightly longer and less broad than in H. ornatula; setae short, brown; several thick spinelike setules, light, transparent and situated subapically; episternum as in H. ornatula, without setae; epimeron with brown covering setae and with a short, primary seta. Epimeron of meso- and metathorax narrow, brownish, with light, round spots; episternum slightly wider than epimeron, without setae; trochantin triangular; seta near the basal border relatively large,
493 dark; both setules situated on the outer side. One gill near the base of the legs, in the pleural region.

Prothoracic sternite (Figure 693) slightly longer than in H. ornatula; anterior margin with a narrowly dark brown border; posterior margin with a broadly dark brown border; rhomboidal sclerites posterior to the sclerite light brown. Ventral side of metathorax with one gill. Number of gill filaments listed on p. 563.

Legs brown, partly reddish brown; setae mainly dark brown; some segments differ slightly in form and chaetotaxy from those of H. ornatula. Anterior margin of fore coxa (Figure 694) with 6 thick, dark brown, short spinelike setae and a moderately long, reddish brown, primary basal seta; anterior surface setae more numerous than in H. ornatula; both primary anterior setae longer than the other setae; 6 dark spinelike setae and 4 small setae at posterior margin; primary posterior seta longer but lighter than the others; covering setae of posterior surface feathered in the subventral posterior part; long, posterior, distoventral seta darker, thicker, but slightly shorter, than in H. ornatula, reaching middle of trochanter. Seta of claw of forelegs transparent, shorter than in H. ornatula.



FIGURES 692–695. Hydropsyche angustipennis Curt.:

692 – posterior margin of mesonotum (A) and metanotum (B); 693 – prothoracic sternite; 694 – trochantin of prothorax and coxa of left foreleg, anterior; 695 – covering setae of the posterior surface of the fore coxa.

494 Mid- and hind coxae longer than in H. ornatula; anterodorsal, spinelike setae situated not only at the depression, but also further basally, reaching base of segment; all setae dark brown; dorsal row at margin of depression with more setae than in H. ornatula; the longest seta situated subapically.

Mid- and hind femora relatively longer than in H. ornatula, with slightly convex dorsal margin. The small, feathered setae in the subventral posterior row on femur and tibia are long.

Primary and covering setae of abdomen as in H. ornatula. Tables 17 and 18 give the number of pleural teat-shaped gill stalks, and the ventral gill stalks of the abdomen (Table 17) and their filaments (after Siltala) (Table 18).

TABLE 17

| Segment | Pleural | Ventral | | |
|---|---|---|---|---|
| | | lateral | intermediate | median |
| 1 | – | – | 2 | – |
| 2 | – | 2 | – | 1 |
| 3 | 1 | 2 | – | 1 |
| 4 | 1<br>2 | 2 | – | 1 |
| 5 | 1<br>2 | 2 | – | 1 |
| 6 | 1<br>2 | 2 | – | 1 |
| 7 | –<br>1 | 2 | – | – |

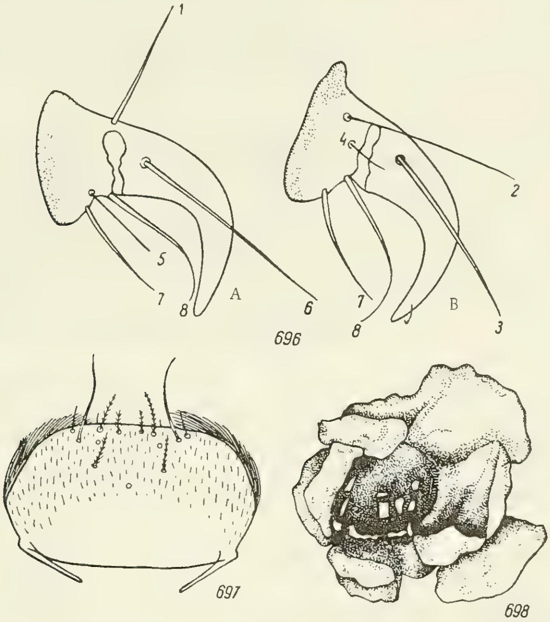
TABLE 18

| Segment | Pleural | Ventral | | |
|---|---|---|---|---|
| | | lateral | intermediate | median |
| Mesothorax | 23–25 | – | – | – |
| Metathorax | 21–26 | – | – | 17 |
| 1 | – | – | 22+23 | – |
| 2 | – | 25+22 | – | 19 |
| 3 | – | 24+26 | – | 17 |
| 4 | – | 23+22 | – | 12 |
| 5 | – | 21+19 | – | 13 |
| 6 | – | 14+11 | – | 10 |
| 7 | – | 7+7 | – | – |
| 8 | – | | | |

Ventral triangular sclerites of abdominal segments 8 and 9 light brown; covering setae light, long, dark brown posteriorly; 10 on segment 8, 13 or 14 on segment 9. Pleural sclerite of segment 9 small, light brown, with a long, strong, dark brown seta and 3 long covering setae. Sides of segment 9 with a light brown triangular sclerite dorsally; posterior margin of sclerite with 3 strong, dark brown setae; lateral seta longer than the others; 2 long, thin, soft, hairlike setae nearby.

Anal legs slightly longer than in H. ornatula; sclerite "b" yellowish brown, with grayish brown dots dorsally; covering chetae of the sclerite stiff, dense, some of them long; distodorsal setae at base of articular rods thin and reddish brown; thin setae of fan-shaped tuft darker than in H. ornatula, reddish brown; setae of distal and ventrodistal margin brown or dark brown; 3 or 4 of them thicker than the others; setae at dorsal margin brownish and thin. As in H. ornatula, sclerite "c" strong, reddish brown, with a thick, straight, dark brown seta and several small setae near it.

Claw (Figure 696) dark brown; setae distinct; basodorsal seta 1 moderately long, light and thin; seta 2 directed upward and slightly outward, longer, thicker and brownish; setae 3 and 6 at sides of the apical part brown, longer than the others; seta 8 at basal part thin, light, curved, longer than the straight, brownish, thicker seta 7; straight, short, thin, brown seta 5 on
495 the outer side near seta 8; small seta 4 situated near margin of the transverse stripe.



FIGURES 696–698. Hydropsyche angustipennis Curt.:

696 – claw of left anal leg, outer view (A), of right anal leg, inner view (B); 697 – labrum of young larva (1st stage) (after Siltala); 698 – anterior end of pupal case from inside, with openings of the membrane.

**Young larva.** First stage. Length 1.8–2.5 mm; length of head and prothorax are the same at beginning of this stage; ratio of length of head thorax and abdomen 1:1.8–2.2:3.2–3.5 at beginning of stage, and 1:1.6–1.8:5.6 at end of stage (Siltala, 1907:413–416); broadest part of body is the head at the beginning of the stage, and first abdominal segments are broadest parts at the end of the stage. Only the mandibles are brown in the freshly hatched larva: head and pronotum become yellowish brown or brownish at end of the stage; other sclerites paler; margin of sclerites dark in some places. Head sutures absent at beginning of stage; they become distinct at end of the stage.

Primary seta of labrum (Figure 697) longer than others; setae 2, 4, and 6 feathered; the other 2 marginal setae thin and small; 3 dorsal pits. Mandibles of simpler structure than in full-grown larva; outer side not yet broadened, without borders; the 2 apical teeth of the 4 teeth of lower blade of left mandible longer than the other 2; basal tooth of mandibles (especially of right mandible) indistinct and small; outer setae feathered.

Submentum trapezoidal, lobes hardly marked; primary setae situated in basal part and not laterally; these setae, seta of cardo and both setae of stipes feathered.

Lateral and posterior margin of dorsal sclerites of thorax brown or dark brown from the 1st stage; black posteromedian spots of meso- and metathorax absent.

Trochantin of propleuron blunt, conical, without basal horn-shaped process; primary seta relatively long; setules long; pleural suture brown; seta of epimeron situated near suture.

Ratio of length of legs 90:100:119; legs almost the same form; setae of legs not yet strongly differing in length; claw of forelegs slightly longer
496 than tarsus; its seta spinelike, short; 2 small blunt spinules further basally. Three small spinules on claws of midlegs and hind legs, basal to the seta.

Abdomen light; segments 8 and 9 without ventral sclerites. Sclerite of section "b" of anal legs yellowish, without dark basal margin; median of the 2 distodorsal setae longer than the outer seta; median fan-shaped tuft of long setae absent. Seta 8 is the longest seta on the claw, much longer than seta 7.

**Second stage.** Length 3.0—4.7 mm. Head slightly flattened; pattern of frontoclypeus more distinct; teeth of mandibles almost as in the full-grown larva. Black median spots appear on the posterior margin of the meso- and metanotum. Claws of legs without spines near basal seta or with only 1 small spine. Sternite of prothorax incomplete, consisting of 2 lateral sclerites.

Isolated ventral gills appear in the lateral and median rows (Table 19, after Siltala).

Ventral sclerites of abdominal segments 8 and 9 present,

TABLE 19

| Segment | 2nd stage | | 3rd stage | | 4th stage | |
|---|---|---|---|---|---|---|
| | lateral | median | lateral | median | lateral | median |
| Mesothorax | 1 | 0 | 3–4 | 0 | 8–14 | 0 |
| Metathorax | 1 | 1 | 2–3 | 2–3 | 6–8 | 6–8 |
| 1 | 1 | 1 | 2–3 | 2–3 | 7–9 | 7–8 |
| 2 | 1 | 1 | 2–4 | 2–4 | 8–10 | 5–9 |
| 3 | 1 | 1 | 2–4 | 2–3 | 7–11 | 5–8 |
| 4 | 1 | 1 | 2–3 | 2 | 6–10 | 4–7 |
| 5 | 1 | 1 | 2–3 | 2 | 7–9 | 3–6 |
| 6 | 1 | 1 | 1–2 | 1–2 | 3–5 | 3–5 |
| 7 | 1 | 0 | 1–2 | 0 | 2–5 | 0 |

**Third stage.** Length 4.5–7.5 mm, ratio of length of head, thorax and abdomen 10:24:62 (10:35:99 in the full-grown larva). Dorsal stripes appear near the pattern of the frontoclypeus. Labrum with a median pit. Sternite of prothorax complete with 2 sclerites posteriorly. Ventral gills more numerous (Table 19), most of them branched.

**Fourth stage.** Length 7–10 mm. Form of body, pattern of head and thoracic sclerites as in the full-grown larva; secondary chaetotaxy abundant. Pleural gills absent; number of filaments of ventral gills shown in Table 19.

**Pupa.** Length of male pupae 8–11 mm, of female pupae 10.0–12.5 mm. Antennae of male reaching end of body, those of female reaching abdominal segments 7–8. Labrum about half as long as wide; tufts black. Right mandible with 3 teeth in addition to apical tooth; left mandible with 4 teeth, the 2nd from the apex small; blades of mandibles finely serrated between the teeth.

Sheaths of fore wings reaching segment 4; sheaths of hind wings reaching segment 5; natatorial setae of mid-tarsi dense, present on segments 1–4 in female pupae, on segments 1–3 in male pupae; 4th segment with only sparse setae or with none.

Presegmental plates present on abdominal segments 3–8, postsegmental plates on segments 3–4; number of spinules as follows: III:5–11; IV:3–6 + 7–19; V:4–8; VI:4–8; VII:5–7; VIII:4–7. Conical pleural gills present on abdominal segments 4–7, ventral gills on segments 2–7; number of filaments in ventral gills shown in Table 20 (after Siltala).

TABLE 20

| Segment | Lateral | Median |
|---|---|---|
| 2 | 20–27 | 19 |
| 3 | 21–28 | 19–28 |
| 4 | 18–25 | 19–20 |
| 5 | 17 | 13 |
| 6 | 10 | 11–13 |
| 7 | 4–12 | 8–10 |

Anal rods longer than in H. ornatula; setae black. Genital appendages of male bracket-shaped, with smooth, curved median margin.

497 Length of case 10–17 mm, made of small stones, sand grains or plant fragments; if made of plant fragments, the case has irregular form; surface of case sometimes irregular; cases sometimes are found in large numbers close together. Membrane at anterior margin with openings (Figure 698).

Mode of life and habitats. Larvae predacious, feeding on small benthic animals, mainly insects (especially larvae of Tendipedidae); they occur in brooks and rivulets with clean cool water and build capturing nets among stones or pieces of wood (see pp. 77, 78).

Distribution. North, west, and central belt of the European USSR. In addition, Europe.

### 4. Hydropsyche pellucidula Curtis

Struck, 1899:342, Figure 30; 1900:27, Figure 46; 1903:118–119, Plate VII, Figure 1. — Ulmer, 1903:115, Figures 8, 20, 33, 43, 69, 78, 105; 1903a:11–15, Figures 1–10; 1909:236, 301, — Lestage, 1921:537, 543, Figure 178. — Lepneva, 1928:25–26; 1940:207.

**Full-grown larva.** Length 17–18 mm; resembling larva of H. angustipennis but darker. Anterior part of frontoclypeus (Figure 699, A; 699, C) with 2 light lateral spots, sometimes also with a less distinct median spot; instead of 3 spots, light specimens have a wide spot with a dark forked median stripe which is divided into 2 lateral spots and one median spot, common in dark larvae; an indistinct light spot in the posterior angle; other part of 498 dorsal surface, except the light band near the occipital foramen and light periocular area, is dark. Ventral side of head, except light stripe near the anterior margin and along the median suture, dark (Figure 699, B); sides between dorsal and ventral dark figure brown. Primary setae as in H. angustipennis, light; seta 9 longer and darker than others. Minute covering setae (Figure 699, D) numerous.

(497)

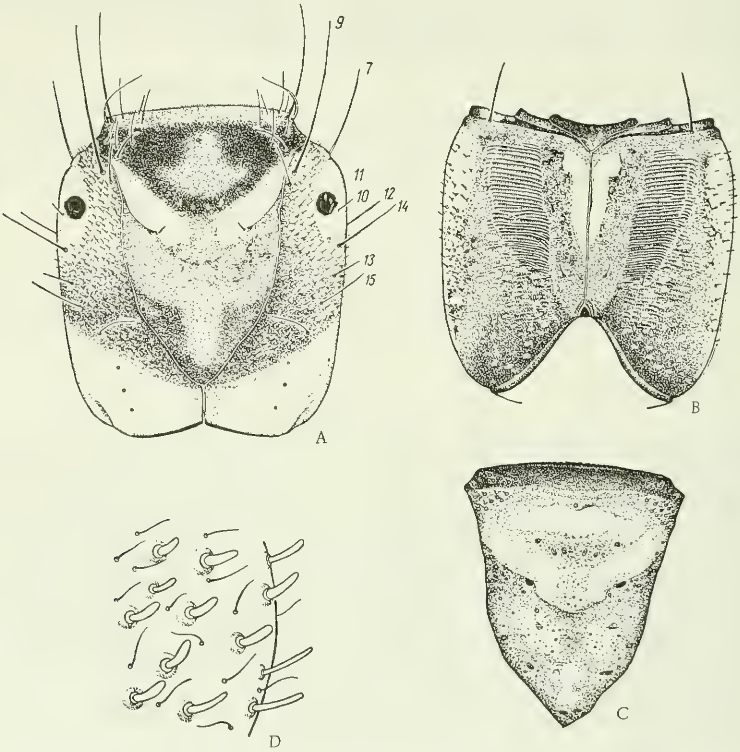


FIGURE 699. Hydropsyche pellucidula Curt. Head, dorsal (A) and ventral (B); frontoclypeus (C), covering setae of head (D)

Labrum slightly broader and shorter than in H. angustipennis (Figure 700, A); lateral tufts and covering chetae of posterior part darker than in H. angustipennis; some of them are short, dark, ordinary setae; primary, light setae of anterior part among secondary setae; seta 5 yellowish.

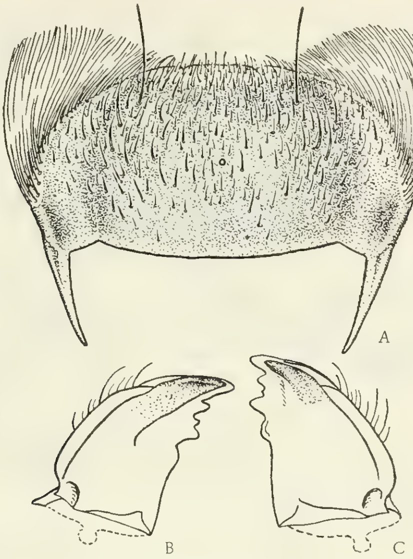


FIGURE 700. Hydropsyche pellucidula Curt. Labrum (A), left mandible, dorsal (B), right mandible, dorsal (C)

Mandibles (Figure 700, B, C) slightly longer and narrower than in H. angustipennis. Each mandible with 2 teeth, which are apical teeth of the upper and lower blade; the only tooth of the upper, very short blade of the right mandible curved slightly upward; lower blade with 3 teeth, the middle tooth shorter than the other 2; basal tooth in the form of a low tubercle; an apical and a small basal tooth on upper blade of left mandible; lower blade with 3 teeth of different size, middle tooth smallest; basal tooth blunt, larger than on right mandible, but markedly lower than in H. angustipennis and of different form; hairs of brush golden yellow; outer setae of mandibles light; both primary setae situated close together, longer than others.

Maxillolabium darker than in H. angustipennis, brown or dark brown, of the same form. Inner margins of lobes of submentum parallel with a narrow, light indentation; oblique row of setae of basal part (unlike in H. angustipennis) mainly situated in posterior half; 2 setae longer and thicker than others; primary seta situated slightly medial to the lateral depression, between basal part and lobes; a similar, relatively long seta slightly anteriorly; 2 setae situated more medially, near base of the lobe, one of them very small; 4 short and several very small setae on the surface of the lobe, slightly anterior to its middle. Setae at base of cardo and in tufts of stipes darker and shorter than in H. angustipennis.

Pronotum reddish brown; primary anterior-angle seta shorter but thicker than in H. angustipennis; large, pale dots distinct; margin of sclerite similar. Meso- and metanotum slightly lighter, yellowish brown with an oblique stripe and large spots laterally; pattern sometimes indistinct; black median spot at posterior margin of mesonotum resembling that in H. angustipennis, but anterior margin is not always uniformly curved; its sides usually form an obtuse angle and its middle is straight; dots anterior and lateral to the spot pale but more distinct than in H. angustipennis (Figure 701, B). Setae similar. Black median spot at posterior margin larger than in H. angustipennis, with 1 or 3 serrations posteriorly (Figure 701, C); median serration always deeper than lateral serrations.*

499

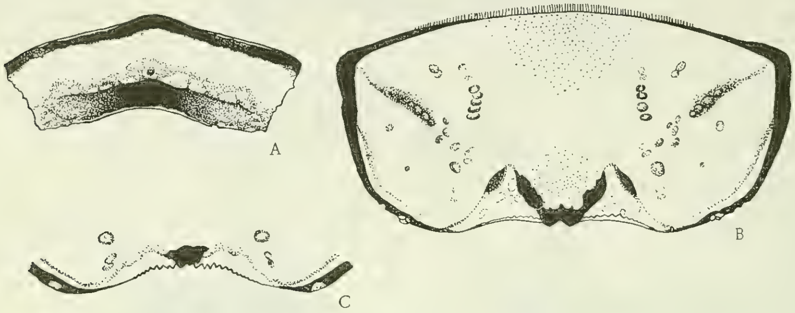


FIGURE 701. Hydropsyche pellucidula Curt. Prothoracic sternite (A), mesonotum (B), median spot of posterior margin of metanotum (C)

Primary seta of prothoracic trochantin blackish brown, longer than in H. angustipennis, almost reaching end of horn; 3 secondary dark chetae near it. Brownish sclerites posterior to large sclerite of prothoracic sternite (Figure 701, A) irregularly rectangular.

Legs dark brown, lighter in some places; their form and chaetotaxy closely resembling those of H. angustipennis; posterior surface of fore coxa with similar feathered setae as in H. angustipennis; anterodorsal margin of mid-coxa and hind coxa less convex than in H. angustipennis.

Ventral gills present on abdominal segment 7. Claw of anal legs thicker than in H. angustipennis.

**Pupa.** Length 11–13 mm. Labrum as in H. angustipennis; setae black. Mandibles reddish brown; right mandible with apical tooth and 3 teeth; left mandible with 4 teeth, the 2 apical teeth smaller than the other 2; blades and teeth finely serrated; primary outer setae of same length.

Mid-tarsi with dense natatorial setae.

Presegmental plates present on abdominal segments 3–8; number of spinules as follows: III:11–12; IV:9–10; V:12–14; VI:9–10; VII:6; VIII:4–6; postsegmental plates present on segments 3–4, as in H. angustipennis. Anal rods and sheaths of genitalia of male pupae as in H. angustipennis.

Pupal case 14 mm long, covered with small stones.

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* This character is not decisive, as stated by Ulmer (1909:236).

Mode of life and habitats. Predacious, building capturing nets; living in brooks and rivulets with cool water, on stony bottom with a moderately strong current.

Distribution. Western, northern and central regions of the European USSR, and Caucasus. In addition, Europe, Iran, Asia Minor, North Africa.

### 5. **Hydropsyche saxonica** McLachlan

Klapálek, 1888:51—54, Figure 18.— Ulmer, 1903:115; 1909:236, 302.— Siltala, 1905:100—102, Figure 22.— Lestage, 1921:536—544.— Lepneva, 1928: 25—26.

**Full-grown larva.** Length 18—20 mm. Head yellow or yellowish brown; pattern brown or dark brown. Frontoclypeus with 4 light spots, lateral spots larger than anterior and posterior spot; anterior spot usually slightly dark; a row of small, light dots on posterior spot. Lyre-shaped figure on dorsal surface dark brown, its dots relatively light. Dark ventral spots very wide, almost reaching anterior margin; they converge posteriorly and bear light dots.

(500)

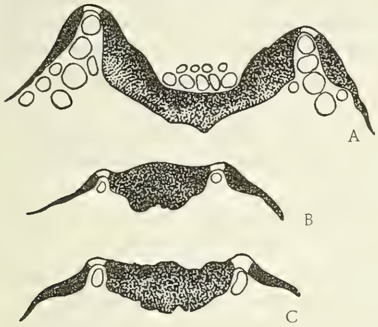

FIGURE 702. Hydropsyche saxonica McL. Median spot of posterior margin of mesonotum (A) and metanotum (B, C)

Labrum laterally with relatively short tufts of hair. Lower blade of left mandible with apical tooth and 3 other teeth; middle tooth smaller than others; basal tooth of the same form as in H. angustipennis but smaller.

Nota of thorax brown or grayish brown, lighter in the anterior angle. Black median spot at posterior margin of mesonotum straight in the middle anteriorly, merging with oblique spots of small curves at an obtuse angle; indentation with spots; small, dark dots lateral to the indentation; spot at posterior margin of metanotum large, serrated posteriorly (Figure 702).

500 Legs yellowish brown; light basal seta of claw of forelegs longer than in H. pellucidula.

Ventral gills of abdominal segment 7 always present.

Anal legs and claws as in H. pellucidula.

**Pupa.** Length of male pupae 11—13 mm, of female pupae 12—14 mm. Antennae of female pupae reaching end of abdominal segments 7—8, those of male pupae longer than body. Labrum with numerous dark setae anteriorly. Blades and teeth of mandibles with distinct serration.

Wing sheaths reaching abdominal segment 4, their ends rounded.

Number of spinules of presegmental plates on abdomen as follows: III:9—14; IV:4—7; V:4—8(11); VI:6—9; VII:5—8; VIII:3—7; segment 3 with an elliptical postsegmental plate with numerous small spinules; plate of segment 4 usually with 11—16, sometimes 9—20 spinules; abdominal segment 7 with ventral gills. Anal appendages of pupa relatively long, almost contiguous posteriorly. Genital appendages of male pupae with slightly undulate inner margin.

Length of pupal case 21–23 mm, with a covering of small stones or plant fragments arranged in all directions. Cases of small Trichoptera are sometimes also used as covering material.

Mode of life and habitats. Rivers and brooks with stony bottom.

Distribution. West of the European USSR (rare). In addition, Central Europe.

### 6. Hydropsyche instabilis Curtis

Ulmer, 1902c:467, Figures 7–9; 1903:115. – Struck, 1903:118–119, Plate VII, Figure 2. – Siltala, 1905:105–107, Figure 24. – Ulmer, 1909: 235–236, Figure 361, a. – Lestage, 1921:535–543. – Philipson, 1953a:17–23.

**Full-grown larva.** Length 17 mm. Darker than the above-described species, with distinct pattern. Sclerotized parts mainly yellow or yellowish brown; dark parts blackish brown or black. Posterior light spot of frontoclypeus wide, with dark dots; anterior and lateral spots of same size or fused; lyre-shaped figure of dorsal surface blackish brown, with dark dots; ventral side with wide, dark, lateral parts; these areas usually converge posteriorly; anterior part of head light.

Labrum with a straight anterior margin. Lateral tufts shorter than in H. angustipennis. Right mandible with 3 teeth in addition to apical tooth on lower blade; middle tooth smaller than others.

Pronotum dark brown or grayish brown, lighter laterally; its posterior margin almost completely black or brownish in the middle of each half; dots on sclerite dark. Meso- and metanotum dark brown, slightly lighter near the anterior angles; dark oblique stripes and groups of dark dots; anterior margin of mesonotum narrow, black, sometimes brownish black in the middle; anterior margin of metanotum brown or blackish; lateral margins of both segments broad, black. Median black spot at posterior margin of mesonotum connected with oblique spots of the small curves by a narrow blackish or brown stripe; anterior margin of spot straight in the middle, forming an obtuse angle laterally, rarely curved, but not as regularly as in H. angustipennis; 6 or 7 large, dark dots near the anterior margin of the spot; similar dots in areas formed by small arcs lateral to the spot. Median black spot of metanotum large, serrated posteriorly, with a small lateral spot. Basal seta of claw of forelegs not reaching end of claw.

(501) TABLE 21

| Segment | Pleural | Ventral | | |
|---|---|---|---|---|
| | | lateral | intermediate | median |
| Mesothorax | 44 | – | – | – |
| Metathorax | 20 | – | – | 22 |
| 1 | – | – | 35+31 | – |
| 2 | – | 46+36 | – | 29 |
| 3 | – | 40+34 | – | 25 |
| 4 | – | 45+35 | – | 22 |
| 5 | – | 36+28 | – | 19 |
| 6 | – | 24+19 | – | 14 |

Gills on abdominal segment 7 absent; number and distribution of gills listed in Table 21 (after Siltala; pleural gills of abdomen not listed).

**Pupa.** Length 9—12 mm. Antennae of male pupae longer than body; antennae of female pupae reaching abdominal segment 7. Three long,
501 primary setae and 1 long, secondary seta lateral to anteclypeus on tubercles among short, dark setae; 4 long, primary setae among setae of the labrum.

Lower blade of left mandible with 4 teeth; lower blade of right mandible with 3 teeth; serration of teeth and blades weak. Natatorial setae on segment 4 of mid-tarsi more numerous in male pupae than in H. angustipennis.

Number of spinules of presegmental plates as follows: III:7—12; IV:4—7; V:4—7; VI:4—6; VII:3—7; postsegmental plate of segment 3 with more numerous spinules; plate of segment 4 with few spinules; only 4—7 spinules in male pupae, 11 in females.

Ventral gills on abdominal segment 7 absent; this is a diagnostic character of this species. Number and distribution of ventral gills and filaments on other segments shown in Table 22.

TABLE 22

| Segment | Lateral | Median |
|---|---|---|
| 2 | 36 | 28—29 |
| 3 | 31—35 | 27—28 |
| 4 | 36 | 28 |
| 5 | 26—28 | 19—25 |
| 6 | 17—18 | 15—16 |

Sheath of male genitalia curved, contiguous posteriorly; penis sheath slightly displaced from the inner side of the genitalia, divided at the end.

Pupal case 14—21 mm long, made of stones and sand grains; the stones may be 9 mm long and 8 mm broad.

Mode of life and habitats. Brooks and rivulets with a stony bottom; occurring in large numbers in some places.

Distribution. North and west of the European USSR and the Caucasus. In addition, Europe, Iran, North Africa.

### 7. Hydropsyche nevae Kolenati

Siltala, 1905:114, Figure 27.— Lepneva, 1928:26—27; 1948b:72—76, Figures 1—5.

**Full-grown larva.** Length 16—17 mm. Head yellow or brownish yellow; pattern distinct (Figure 703); dorsal surface flattened. Frontoclypeus large, broad, with light spots; number of spots sometimes only 4, but they are different from spots of the preceding species; anteromedian spot longitudinal, oblong, narrower in the middle; largest posterior spot transverse, reaching the frontal sutures; anteromedian spot sometimes divided into 2; posterior spot sometimes divided into 3 spots (one median and 2 lateral spots), so that there are 5 or 7 spots; if there are 2 anterior median spots, the number of spots is 9.* Posterior angle of sclerite dark, with large, light dots with dark outline.

Dorsal stripes of head dark brown, interrupted in the middle; they are represented by a narrow, dark stripe along the frontal sutures anteriorly; 502 a wide, dark, posterior spot with light dots and narrow, blackish brown border. A narrow, dark stripe, slightly broader posteriorly along the gular suture; broad, dark stripes laterally; large, light dots with dark margin posterior to them. Other part of ventral surface light, with indistinct light dots posteriorly. Gula fused with pregula, dark brown, some of it forming part of the head capsule.

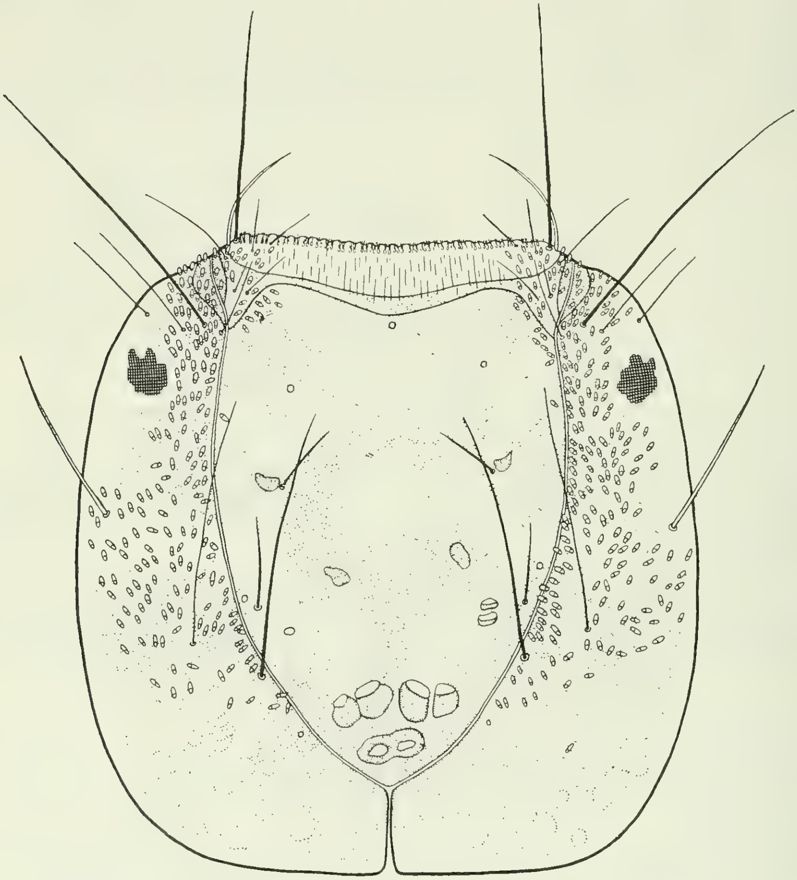

FIGURE 703. Hydropsyche nevae Kol. Head dorsal (only part of setae shown)

Small covering setae of dorsal surface of 2 types (Figure 704), either cylindrical with a blunt apex, or thin, light, and usually divided; frontoclypeus without covering setae in its greater part; setae form a dense covering only in the anterior angles; short, light, flat setae which are distally serrated or fimbriated at the crenulate anterior margin. Setae sparser on sides of head, absent on ventral side and on light area around occipital foramen.

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* As shown by Siltala (1905:Figure 27).

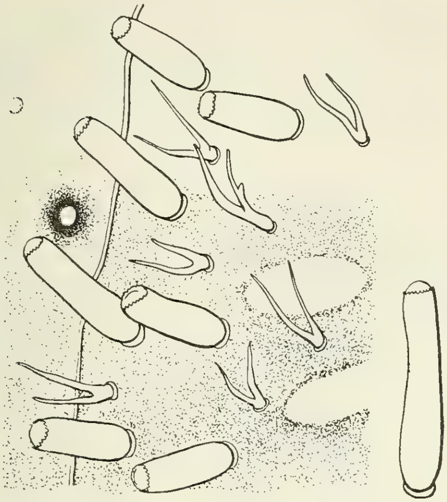

FIGURE 704. Hydropsyche nevae Kol. Covering setae of head

Primary setae thin. Lateral anterior-margin seta situated in the angle of the frontoclypeus light, curved; intermediate setae straight, brown, 503 strong, relatively long; median seta small and light; anterior frontal seta light, thin, small, situated among secondary anterior-angle setae; mediofrontal seta situated medial to dark spots of tentorial pit; posterior seta situated on dark background near frontal suture; both last setae slightly thick. Seta 9 situated lateral to frontal sutures and as long and dark as the intermediate frontal seta; thin yellowish seta 11 situated near it; seta 7 straight, brown, slightly shorter than seta 9; seta 10 light, short; seta 14 situated posterior to the eye, strong, moderately long, dark brown; seta 12 light yellow, short; seta 15 long, yellow, thin, directed anteriorly; seta 16 situated near frontal suture, posterior to posterior frontal seta. Ventral seta 8 situated near anterior margin, small, straight and brown; seta 18 very small, light, setuliform.

Labrum (Figure 705) mainly dark brown; dark median space covered with minute setae, separated by yellow lateral stripes from darker spots near the posterior angles; lateral tufts as in H. angustipennis. Seta 5 long, yellowish, well marked.

Mandibles (Figure 706) as in other species of the genus; each mandible with 2 long apical teeth; upper blade of the left mandible with 1 additional tooth; lower blade with 3 teeth of the same size; median brush of left mandible golden brown; upper blade of right mandible without teeth, lower blade with 3 teeth, median tooth smaller than lateral teeth; basal tooth of both mandibles with broad base and slightly blunt apex; outer setae light; both primary setae close together, slightly curved; secondary setae few in number and of different length.

Submentum brown (Figure 707), lighter than gula, darker at base of lobes; lobes dark brown, rounded anteriorly, with rugose surface; an oblique row of short setae, some of them thick and dark brown, on sides of basal part; dark, primary setae of submentum situated laterally, near base of lobes, relatively long; a similar, long but lighter secondary seta near it; lobes with short, dark setae, some of which are thick. Cardo and stipes yellowish; setae near base of cardo and of brushes of stipes brown.

Pronotum light yellow laterally, mainly dark brown in the middle, subdivided into an anterior and posterior part by a light stripe which is interrupted near the median suture; this stripe is absent in dark specimens; large lateral dots indistinct and light. Anterior margin narrow, brown; lateral margin broad, black; posterior margin brownish and serrated. Anterior-angle seta dark brown, moderately long; 2 thin, small, hairlike secondary setae, and 2 long, dark, blunt setae on the outer side, near this seta. Medioanal seta brownish, strong, moderately long; a thin, light, small, asymmetrically situated seta in the anterior 3rd on each side of the suture; a row of 3 similar setae in anterior part; 1 seta situated in lateral part.

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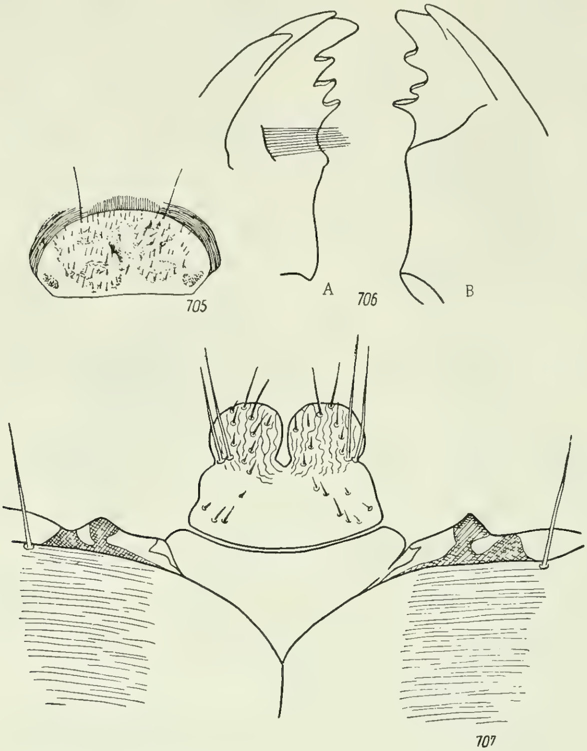

FIGURES 705–707. Hydropsyche nevae Kol.:

705 — labrum, dorsal; 706 — mandibles, dorsal: left mandible (A), right mandible (B); 707 — anterior margin of head, ventral, gula and submentum.

Meso- and metanotum yellow; oblique, dotted stripe in anterior angle brownish and dark; dots grayish brown; anterior margin brown, narrowly black laterally; lateral margin completely black. Medioanal spot of mesonotum (Figure 708, A) with a deep rectangular indentation; stripes of small arcs narrow, brownish; indistinct and light dots situated in indentation; medioanal spot of metanotum (Figure 708, B) small, crenulate anteriorly; Medioanal seta of 3 setae of anterior part of mesonotum brown, moderately

504 long; 2 other setae small and thin; a dark, short, blunt seta in anterior angle; a brownish, moderately long seta in posterior part near curvature; a large, dark, blunt seta medial and lateral to this seta. A thick, blunt, long, dark seta, and 2 small, thin, hairlike setae on metanotum, lateral to spot at the posterior margin; a pair of asymmetrically situated, moderately long, blunt setae in the anterior part.

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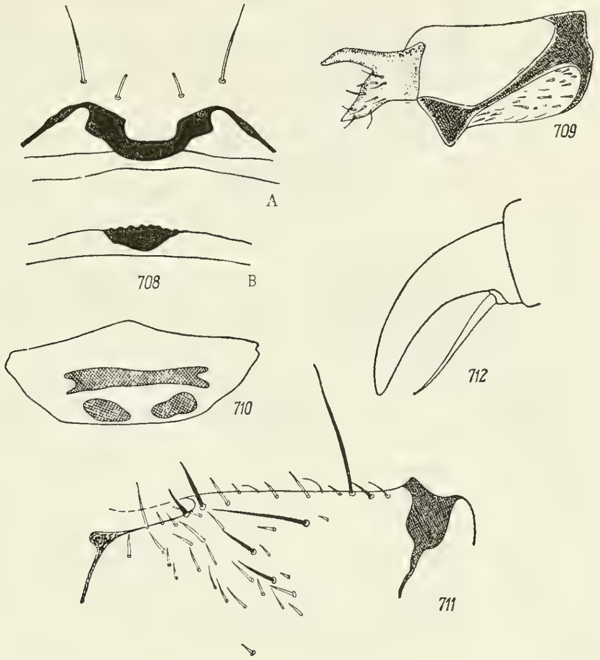

FIGURES 708–712. Hydropsyche nevae Kol.:

708 – median spot of posterior margin of mesonotum (A), of metanotum (B); 709 – propleuron; 710 – prothoracic sternite; 711 – coxa of right foreleg, anterior; 712 – claw of foreleg.

Basal horn of trochantin (Figure 709) dark brown, narrow; apical horn light brown, darker at the end; setules situated subapically; primary seta situated among secondary setae near base and lateral to small horn; episternum yellow, smooth, without setae; pleural suture reddish black; epimeron brownish, with short, light brown, thick setae and 1 primary seta. Pleural sclerites of meso- and metathorax brownish yellow, with a black pleural suture and a reddish brown stripe on the trochantin. Primary seta of trochantin strong, blackish brown; both setules light.

Prothoracic sternite consisting of 3 sclerites, an anterior, transverse sclerite and 2 posterior sclerites (Figure 710).

Secondary chaetotaxy of legs rich, but less rich than in the preceding species; secondary setae mainly light. Both primary, anterodorsal

setae dark on fore coxa (Figure 711); basal seta long; apical seta short, spinelike; a row of short thin light setae between these 2 setae; 1 anterior
505 primary seta long, the 2nd spinelike, situated in a group of 3 similar, short, dark setae; posterodorsal seta near apex of indentation dark, strong, moderately long; the similar, dark, secondary seta situated near margin of indentation; anterior ventrodistal seta short, brown; posterior seta long, dark; a row of short, fine setae at margin. Covering setae of coxa feathered, thicker on anterior than on posterior surface, where they are more numerous in the apical part.

Primary, anterior seta of trochanter reddish brown; 3—4 ventral setae in distal part light brown with 1 short, light seta; several feathered setae among the dense covering setae.

Both primary dorsal setae of femur dark brown; posterior primary seta reddish brown, strong, situated subventrally; anterior primary seta pale, spinelike, short, situated closer to dorsal margin. Ventral setae (including primary setae) dark, thick, moderately long, directed anteriorly; dense, fine, short, spinelike setae posterior to them. Eight dark secondary setae and 5 light setae subdorsally in anterior part; sparse, small, light, hairlike setae in basal and dorsal part; some of which curve to the surface; sparse covering setae on posterior surface; among them, 4 short, thick setae in a longitudinal row.

Distodorsal setae of tibia and tarsus darker and thicker than in H. ornatula. Basal seta of claw light, longer than in H. angustipennis, almost reaching end of claw (Figure 712).

Secondary setae few in number in distal part of mid- and hind trochanter; a number of feathered setae among covering setae of trochanter.

506 Subapical primary ventral seta of femur long and brown (a specific character of H. nevae); 2nd primary seta indistinguishable among the numerous, short, light secondary setae; thin, small, feathered chetae on anterior ventral row; Posterior primary seta situated subventrally, strong, dark; anterior primary seta small, spinelike, yellowish.

507 Feathered setae present on distal part of tibia, anteriorly and ventrally, and on anterior part of tarsus; distodorsal seta of tibia light, that of tarsus dark brown.

Claws thicker than in H. angustipennis; basal, spinelike seta small.

Primary dorsal setae of abdomen brown or yellowish, covering setae reddish brown.

Ventral sclerites of segment 8 much smaller than those of segment 9; sclerites mainly yellow; setae conical, shining, reddish brown; posterior margin of sclerites of segment 8 with 4 long, dark setae, and 2 or 3 short setae; posterior margin of sclerites of segment 9 with 6 or 7 long and 3 or 4 short setae; lateral setae on both segments larger than the others; small pleural sclerite of segment 9 with a long, thick seta and 2 or 3 covering setae. Small dorsal sclerites of segment 9 yellowish; lateral seta at posterior margin long, dark brown; intermediate and medioanal setae small and thin.

Sclerite "b" of anal legs shining brown, with reddish brown apical margin; both dorsoapical setae long, reddish brown; a row of brown, moderately long, and short setae at lateral margin; a long, brown, thick seta on a membrane on ventral side, near apical end, on a small sclerite.

Sclerite "c" reddish brown, with a similar dark, strong, curved distomedian seta, which reaches end of claw; a group of small, light setae near this seta.

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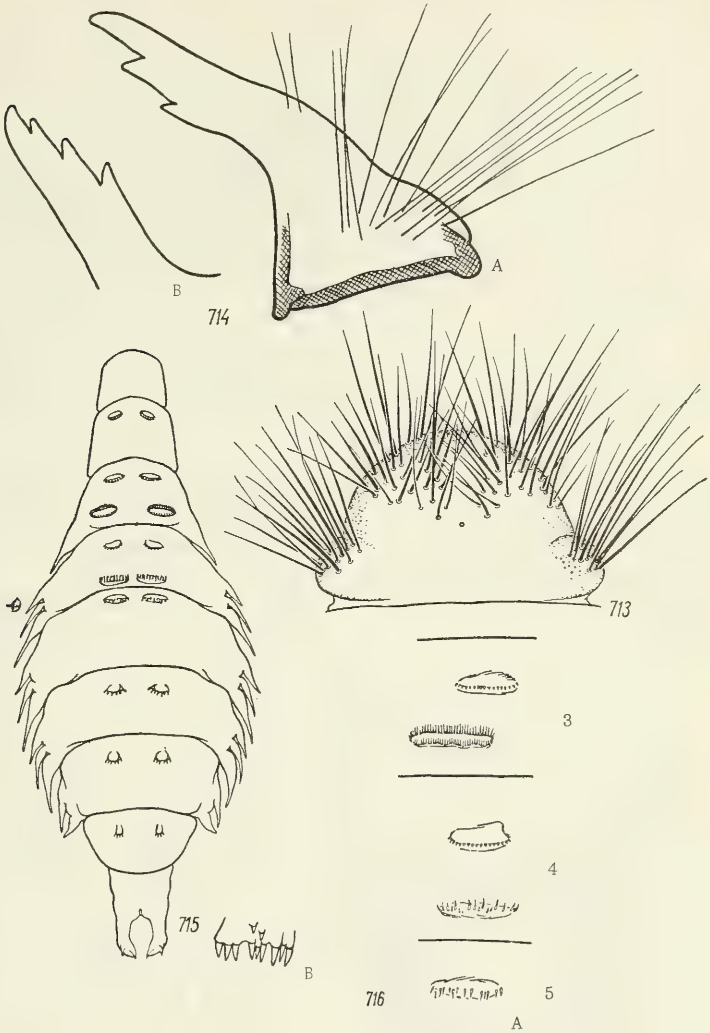

FIGURES 713–716. Hydropsyche nevae Kol. Pupa:

713 – labrum; 714 – mandibles, ventral: left mandible (A), right mandible (B); 715 – abdomen of pupa, dorsal; 716 – plates of holding apparatus on abdominal segments 3, 4 and 5 (A), presegmental plate of segment 8 (B).

Apical part of claw shining, dark brown; setae thin and light.

**Pupa.** Length 11–12 mm. Antennae of female pupae reaching end of segment 7, those of male pupae end of body; 1st antennal segment with

3 closely standing, thin, short, black setae. Sides of anteclypeus with tubercles with numerous, strong, black setae; similar setae on dorsal surface of labrum (Figure 713); except in a few small areas, primary setae indistinguishable among secondary setae.

Apex of left mandible with 2 (sometimes 3) teeth; right mandible with 3 teeth in addition to apical tooth (Figure 714); a group of 13 or 14 black setae 508 on ventral side, near base; a primary, short, dark seta on outer side in about the middle; a 2nd smaller seta nearby, situated more ventrally.

Wing sheaths reaching segments 4–5. Natatorial setae of mid-tarsi relatively long, dense on segments 1–3, shorter and sparser on segment 4.

Holding apparatus of abdomen (Figures 715 and 716). Presegmental plates present on segments 2–8, postsegmental plates on segments 3 and 4. Number of denticles as follows: II:17–18; III:23–24 + 56–58; IV:18–20 + 22–24; V:18–19; VI:15–17; VII:12–13; VIII:7–8. The presence of plates on segment 2 is a specific character of H. nevae; presegmental plates of segments 3–5 with numerous denticles, plates pectinate and larger than others; postsegmental plates of segment 3 oblong, elliptical, covered with anteriorly-directed needle-shaped spinules; they are broad on segment 4, larger than the presegmental plates, almost touch in the middle (Figures 715 and 716).

Gills with conical, flattened stalk on segments 3–7; their numbers as follows: III:1, IV:3, V:3, VI:3, VII:2; gills of segment 7 small, poorly marked; posterior gill on segments 4–5 broad near base, directed posteriorly, the other 2 gills much shorter and thinner.

Pleural gills of pupa larger than larval gills. Ventral gills present on segments 2–6.

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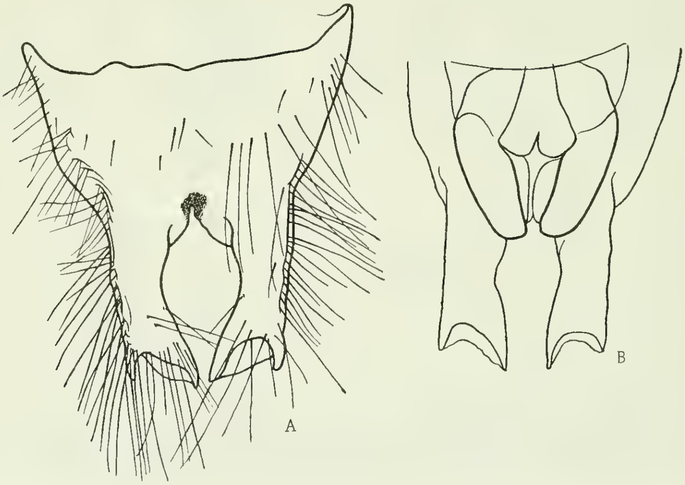


FIGURE 717. Hydropsyche nevae Kol. End of body of male pupa, dorsal (A) and ventral (B)

Anal rods (Figure 717) slightly shorter than in the preceding species, with strong, black, outer setae. Genital appendages of male pupae slightly curved; inner sides almost straight; penis sheath divided into 2 short, broad, rounded lobes.

Mode of life and habitats. Larvae predacious, weaving capturing nets; live on solid bottom, often on stones and wood. They occur in rivers and rivulets with rapids in hills and foothills, as well as in larger streams. They are known from the Neva, rivulets in Karelia, Kola Peninsula, Northern Urals and Upper Pechora; they are abundant in the Biya and Yenisei and its tributaries (Mana, Kacha, Angara, Stony- and Lower Tunguska), rivulets in the Western Sayan (Greater Kebezh, Lesser Kebezh); they often occur together with Arctopsyche ladogensis Kol.

Distribution. Mainly Eastern and Western Siberia, Altai, Sayans, Kamchatka, northeast and north of the European USSR. In addition, Finland, Scandinavia.

## 2. Genus **Cheumatopsyche** Wallengren

**Full-grown larva.** Smaller than larva of Hydropsyche; length at most 10.0–10.5 mm. Sclerotized parts of body yellowish; pattern pale, indistinct. Head as in Hydropsyche, short and broad; frontoclypeus of same form. Covering setae small, sparse, setuliform and hairlike, rarely blunt.

Mandibles shorter than in Hydropsyche, broad in basal part; basal tooth characteristic, differing from that of Hydropsyche, its apex directed posteriorly. In addition to median brush of left mandible, apical part with a row of small hairlike spinules on outer side of left and right mandible.

Narrow median black spot at posterior margin of mesonotum; median spot of metanotum small, dot-shaped.

Number of gill filaments smaller than in Hydropsyche. Distodorsal tuft of setae of anal legs less dense than in Hydropsyche.

**Pupa.** Length 6.0–6.5 mm. Antennae of male pupae shorter than in Hydropsyche, not curved at the end. Crotchets on plates of holding apparatus less numerous than in Hydropsyche; postsegmental plates smaller and of different form.

Genital appendages of male pupae shorter and broader than in Hydropsyche, pointed at inner side of end; penis sheath short and broad.

Pupal case to 10 mm long, made of sand grains, small stones or detritus.

Mode of life and habitats. Larva predacious, building small capturing chambers as does Hydropsyche. They live in rivers, avoid large, calm rivers in the plains (not found in the Volga, Dnieper or Ob); they often occur in large and small rivers and rivulets with many rapids in the foothills.

Distribution. Northwest (rare), west, southwest and south of the European USSR, Caucasus, Middle Asia; southern and Eastern Siberia (Yenisei basin), Amur Region, Maritime Territory. In addition, Europe, Africa, Asia, North America, Australia.

509 **1. Cheumatopsyche lepida** Pictet

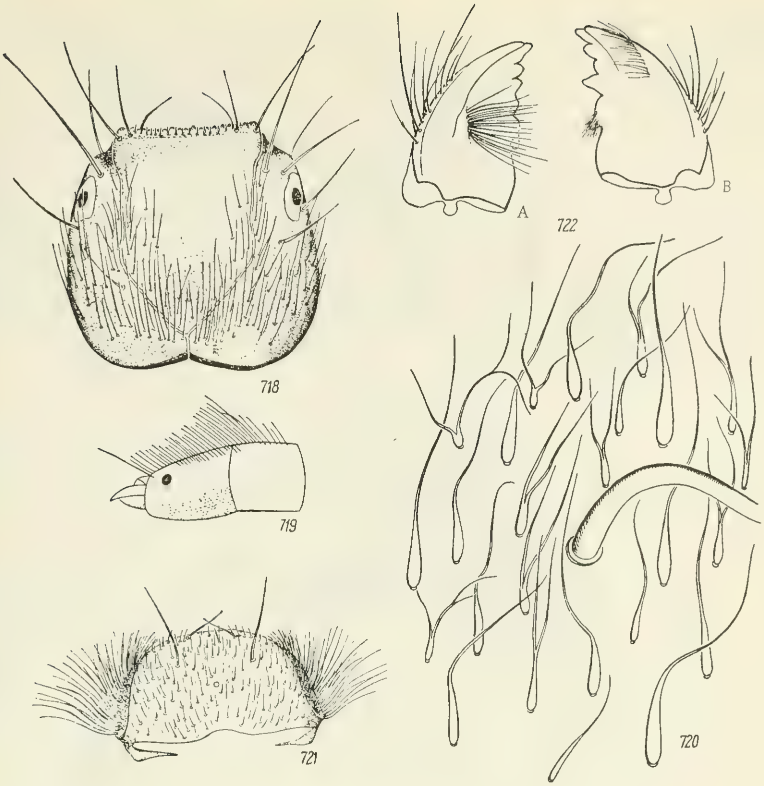
Pictet, 1834:207, Plate XVIII, Figure 1, a, b. — Siltala, 1905:108—111, Figure 25. — Ulmer, 1909:235, 300, Figure 360. — Lestage, 1921:538—543. — Lepneva, 1932:82—84, 108—109, Figures 1—10; 1940:206—207, Figure 154, b.

**Full-grown larva.** Length 10.0—10.2 mm. Head mainly light yellow, with an indistinct brownish lyre-shaped dorsal figure; frontoclypeus slightly darker anteriorly and posteriorly; anterior margin mat brown, crenulate, with rounded processes of different size (Figure 718); characteristic, divided, small, tuftlike covering setae between the processes; tentorial pit slightly dark; small, light dots in posterior angle. Clypangulus dark, relatively large. Anterior-margin setae light; lateral seta as in Hydropsyche, curved inward; intermediate seta situated nearby, larger, straight; shorter median seta situated at a distance; angle of sclerite and clypangulus with several secondary setae; primary frontal setae small, situated among secondary setae, indistinct. Covering setae (Figure 720) situated on the indistinct, brownish, lyre-shaped figure and on the frontoclypeus, mainly hairlike, with long, thin end; numerous hairlike setae along frontal sutures
510 and in posterior part thin, whitish, directed anteriorly (Figure 719); covering setae sparse and very small in middle of frontoclypeus. Large, indistinct, light dots on sides of posterior part of dorsal surface; following setae are present lateral to frontal sutures, among the light secondary setae: straight, brownish, long seta 9; near it thin light seta 11; seta 7 straight and shorter than seta 9; seta 12 posterior to the eye, light brown, thick; setae 14 and 15 thin, light; seta 15 long, directed anteriorly; seta 16 near the suture, thick, brown. Ventral side of head light without dark areas lateral to gular suture characteristic of Hydropsyche; postgula forming a small, reddish brown sclerite; gula fused with pregula, golden brown; anterior margin of head capsule also goldenbrown. Seta 8 light yellow, straight, shorter than 7; seta 18 (unlike in Hydropsyche) thick, spinelike, pointed.

Labrum (Figure 721) with short, lateral margin of dorsal sclerite and rounded anterior margin; labrum mainly golden brown, light yellow posteriorly and laterally. Covering setae with broad base and long hairlike end as on the dorsal surface; primary setae among similar secondary setae thin, light, some of them large.

Mandibles (Figure 722) massive, dark brown. Upper blade of left mandible with a large, projecting, apical tooth; a longitudinal row of small, thin, hairlike spinules on outer side near base; lower blade of left mandible with a large apical tooth and 3 smaller teeth; basal tooth large, directed posteriorly; median depression with a brush of chetoids which are longer posteriorly. A row of small spinules on upper blade of right mandible, on outer side, near large apical tooth; 2 small teeth on lower blade near large apical tooth; a 3rd, larger, basal tooth posterior to these 2 teeth, of same form as on left mandible; a row of small spinules on outer side near the base of this tooth. Outer setae of mandibles numerous, light; of the 2 primary setae one is long, the other shorter in the apical part.

Submentum golden brown, relatively broader than in Hydropsyche; its rugose lobes short and almost in contact distally; anterior margin serrated; short, light setae laterally in basal part; 3 long, light setae on outer side near base; 1 of these setae primary; most secondary setae of submentum short and light, some of them thin and very small.



FIGURES 718–722. Cheumatopsyche lepida Pict.:

718 – head, dorsal; 719 – head and pronotum, lateral (diagrammatic); 720 – covering setae of head; 721 – labrum; 722 – mandibles, dorsal: left mandible (A), right mandible (B).

Pronotum golden brown, of the same form as in Hydropsyche; anterior margin brownish; lateral margin narrow, black; posterior margin narrow, slightly darker and broader in middle and near posterior angle; sclerite with large, indistinct, light spots. Short, brown, dense, strong setae at anterior margin; among these, thin, whitish, hairlike setae, which become gradually longer toward median suture, in the middle of each half; median group of white chetae only slightly smaller than sclerite (Figure 723,A); these soft, hairlike setae, with similar setae along frontal sutures, form a horseshoe-shaped crown above the head. The following setae are well marked: strong, brownish, anterior-angle seta, the long, yellowish, medioanal seta and 2 short light setae laterally in anterior part; covering setae small; those near the base are thick, with long transparent, filiform end; some very small setae divided; covering setae sparser posteriorly and anteriorly.

Meso- and metanotum yellowish white; dots indistinct, grayish; narrow lateral margin and median spot on both sclerites reddish brown; oblique stripes of anterior-angle region more distinct on metanotum than on mesonotum; covering setae not divided, setae on metanotum sparser than on mesonotum. Median spot of mesonotum (Figure 723, B) relatively narrow, irregularly curved; its anterior margin crenulate; straight middle stripe either absent or very short; median spot of metanotum small, serrate, slightly broader anteriorly (Figure 723, C). Medioanal seta yellowish, longer and thicker than others; 1 short, thin seta on mesonotum, situated on each side of this seta; 2 similar light, small setae situated in the middle, close to anterior margin, and laterally near the margin; 1 seta on the metanotum, situated lateral to median seta; 2 pairs of setae situated behind each other in the anterior part, closer to margin; 1 seta in lateral part as on mesonotum. Covering setae near anterior margin situated close together and denser than on the other surface; several, short, thick setae (which are blunt on metanotum) near anterior angles.

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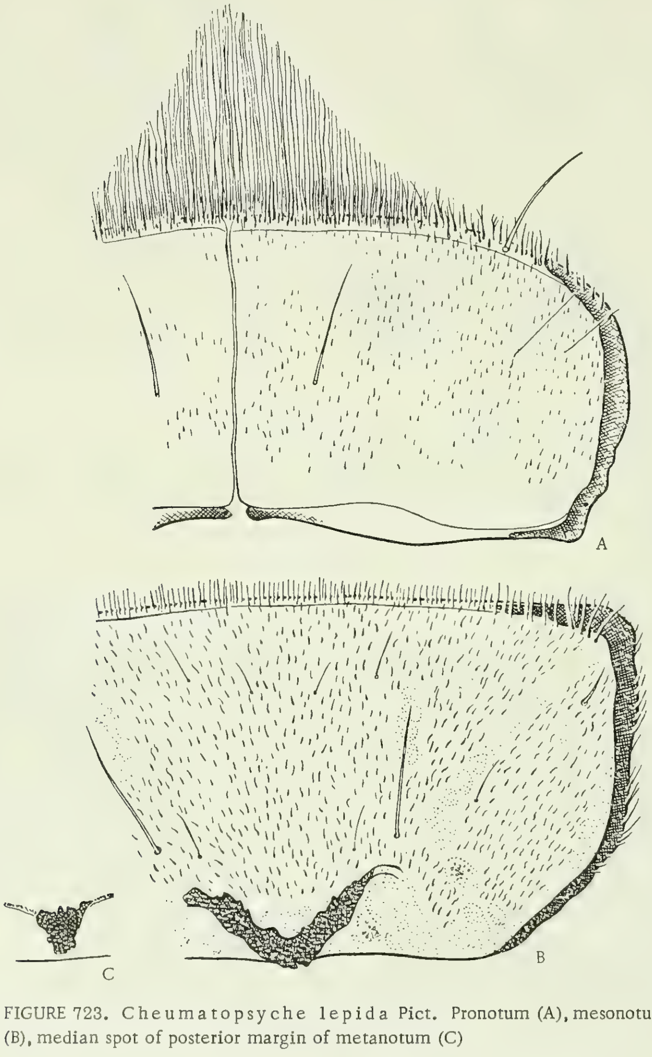

FIGURE 723. Cheumatopsyche lepida Pict. Pronotum (A), mesonotum (B), median spot of posterior margin of metanotum (C)

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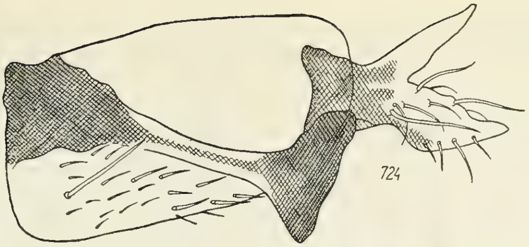
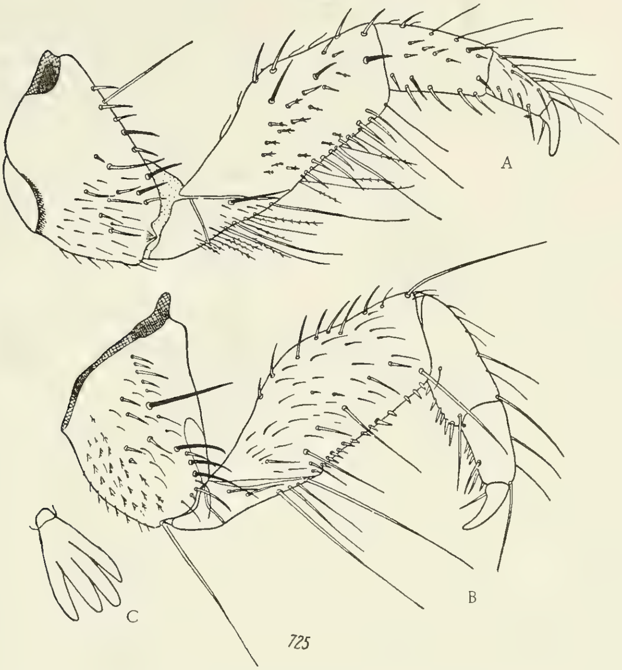




FIGURES 724 and 725. Cheumatopsyche lepida Pict.:

724 – propleuron; 725 – left foreleg, anterior (A), right foreleg, posterior (B), subventral, covering seta of posterior surface of coxa (C).

Basal part of prothoracic pleural sclerite irregularly rectangular (Figure 724); pleural suture almost forming its diagonal, broader near end, dark reddish brown, narrow and light in the middle; difference between size of epimeron and episternum smaller than in Hydropsyche; episternum without setae; epimeron with short, thick setae, small, covering setae and a yellowish brown primary seta near base. Unlike in Hydropsyche, trochantin narrower basally and separated from forked distal part like a neck; hornlike process pale, almost straight, blunt; basal lobe-shaped branch narrowed like a teat; primary seta large, thick, situated near base of lobe, secondary setae few in number.

512 Ratio of length of legs 85:100:110. Forelegs (Figure 725) as in Hydropsyche, more massive and shorter than midlegs and hind legs. Distodorsal indentation of coxa shallow; anterior basodorsal seta brownish, long, thinner

than others; 2nd primary seta situated subapically near indentation, thick, spinelike, dark; 5 short (dark and light) secondary setae at margin; posterodorsal seta spinelike, brown, shorter than basal seta; 4 smaller, brown, thick, secondary setae and 2 thin setae near posterior margin of distal indentation; anterior surface setae thin, strong, of varying length; 2 primary setae among them; small, feathered, covering setae, which are denser on the ventral side, on the anterior surface except in basal part and on a narrow, subdorsal stripe; covering setae sparse on posterior surface: 10 or 11 short, flat palmate setae ventrally and subventrally among the covering setae; these palmate setae are divided into 3 or 4, short, blunt, fingerlike lobes near the
513 apical margin. Anterior distoventral seta short, brown, curved; posterior seta straight, long and brown; 3 or 4, short, curved setae between them.

Anterior primary seta of trochanter spinelike, relatively long; posterior primary seta replaced by 2 small setae; anterior surface of segment with small, covering setae partly feathered, extending also to distal margin of basal segment; 2 of the primary setae of ventral side long and brown, 1 situated apically, the 2nd closer to the middle; light setae of varying length between them; many delicately feathered; short, very small, feathered setae further basally.

Basodorsal seta of femur yellowish, short, spinelike; similar subdorsal spinelike, dark seta near it; distodorsal seta long, light brown; short, mainly light, secondary setae dorsally and subdorsally, some of them spinelike; anterior, primary seta forming a short massive spine; a row of small, brownish or yellowish, spinelike setae of varying size further basally; these setae are partly feathered basally; a row of dense, short and long, brownish, strong setae situated ventrally and subventrally; 2 primary setae among them; 3 thin, light, long, feathered setae and a simple, very thin, light seta situated near base ventrally; short, blunt, thick spines ventrally at margin. Posterior, primary seta brownish, long, situated subventrally near margin; short setae and 2 or 3 long, yellowish setae further basally; small, sparse, hairlike setae situated subdorsally.

Both dorsal primary setae of tibia light, yellowish, long, situated one behind the other; secondary dorsal setae also light but shorter than primary setae, many of them very small; short spinelike setae anteriorly and subdorsally; some of them very small; spinelike and dark primary anterior seta situated distally; posterior primary seta long, thin, yellowish, situated subventrally; both primary spines situated ventrally and distally close together, strong, blunt and slightly yellowish; 3 similar spines further basally at the ventral margin.

Distodorsal seta of tarsus long and yellowish; the other dorsal and subdorsal setae are light, vertical, and 2, light, spinelike setae curve to the surface; there are several short spinelike setae and very small, thick and thin setae; 3 short, brownish, thick setae anteriorly and subventrally; small, light, spinelike setae on ventral side; 2 large primary setae situated close together subapically. Claw with a light, almost transparent, thin basal seta.

Midlegs and hind legs (Figure 726) slightly longer than forelegs but much thinner. Basal part of coxae long, with only small light, thin and thick setae dorsally; a light yellow seta, slightly longer than the others, is probably a primary basodorsal seta; a regular row of short, brownish setae in apical part at anterior margin; 2 strong, brown, moderately long setae in this row;

apical seta shorter than basal seta; a posterodorsal row of setae at indentation; a posterior, primary seta near apex of indentation; this seta is long on the midlegs, short, spinelike, smaller than several secondary setae of posterior part on the hind legs. Covering setae sparse, light, especially anteriorly, a row of feathered setae among them; anterior part subventrally with 3 palmate setae which are very small on the midlegs and slightly larger on the hind legs; total number of setae and number of palmate setae larger on posterior surface than on anterior surface of coxa. Distoventral setae long; anterior seta slightly shorter than posterior seta on midlegs and longer on hind legs.

(514)

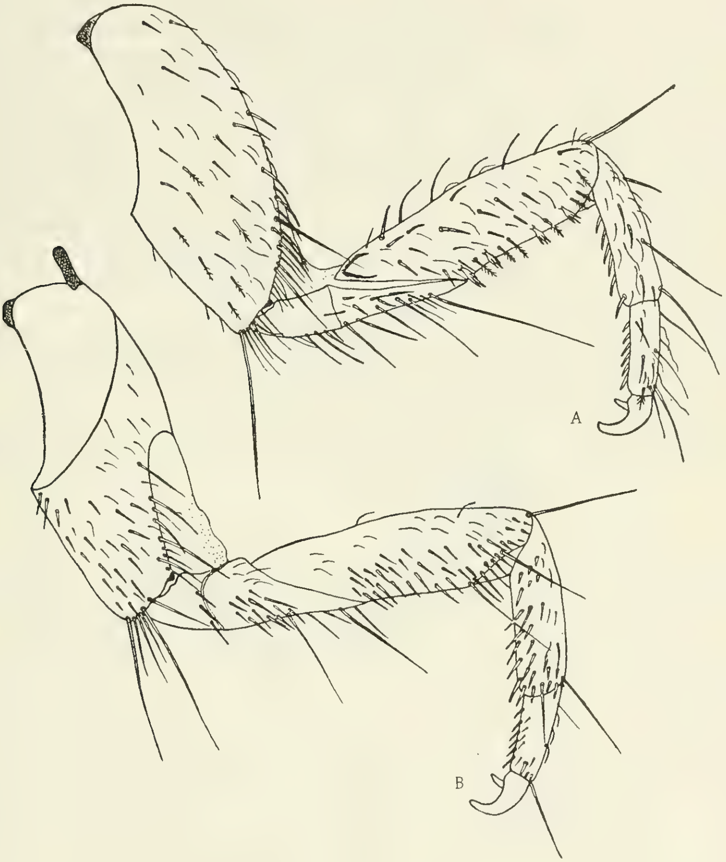


FIGURE 726. Cheumatopsyche lepida Pict. Hind leg: left leg, anterior (A), right leg, posterior (B)

Setae of trochanter spinelike, of different length, especially abundant posteriorly and ventrally; a few setae on anterior surface; setae near apical margin of basal segment short, light and sparse; posterior primary seta long and strong; subapical ventral, primary seta longer than others; several long setae among secondary ventral setae.

Femur of midlegs and hind legs with short, light, thin setae dorsally and subdorsally; primary apicodorsal seta brownish, long, thin; basodorsal seta in the form of a small, light spine. Primary anterior seta of femur spinelike, dark; posterior primary seta moderately long, situated subventrally; anterior surface with short, thin setae; a row of palmate and feathered chetae subventrally; the whole subventral region of posterior surface and ventral stripe of segment bear a brush of strong, spinelike setae with long, light, thin ends; setae on ventral side of midlegs and 1 seta on ventral side of hind legs very long.

514 Tibia dorsally with small, sparse setae and 3 thin, long setae; distodorsal seta brownish, long; a similar long, yellow seta further basally. Posterior and anterior surface with thin, short, sparse, light setae, with spinelike setae subventrally and more abundant on posterior part of hind legs; primary, anterior, distal seta dark, short and blunt; posterior primary seta long, situated subventrally; ventral setae form 2 rows of spines; 2 primary setae situated distally, longer than the others; a light spinule between them, near the margin; feathered setae among secondary setae of comb.

Mid-tarsus and hind tarsus with a long brownish distodorsal seta; a shorter light seta nearby, anteriorly; surface with sparse, minute setae anteriorly; 2 larger setae among them on hind legs; a feathered seta situated further distally; 2 rows of strong spines on ventral side, including 2 primary setae.

Claw dark, blunt, strongly curved; instead of the light, thin seta on the forelegs, there is a short, massive, blunt spine.

Abdomen light, yellowish; covering setae brownish; small, blunt setae on ventral side sparser than on dorsal side; blunt, covering chetae
515 characteristic for Hydropsyche are absent in Cheumatopsyche.
Primary setae thin, brownish, darker and stronger posteriorly.

Gill filaments fewer than in Hydropsyche; number given in Table 23.

TABLE 23

| Segment | Pleural | Ventral | | |
|---|---|---|---|---|
| | | lateral | intermediate | median |
| Mesothorax | 8–10 | – | – | – |
| Metathorax | 8 | – | – | 8–9 |
| 1 | – | – | 8+5 | – |
| 2 | – | 8+8 | – | 7 |
| 3 | 1–2 | 6+6–7 | – | 5 |
| 4 | 1–2 | 7+8 | – | 6–5 |
| 5 | 1–2 | 7+6 | – | 4 |
| 6 | 1–2 | 5+4–7 | – | 4 |
| 7 | – | 5+3 | – | – |

Gills on pleural region of abdomen little marked; they consist of 1 or 2 short filaments near posterior margin on segments 3–6.

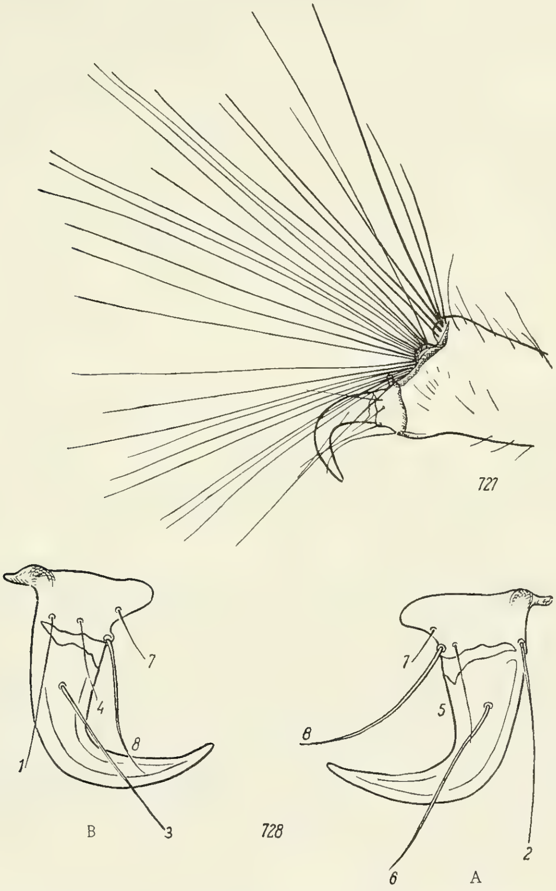
Small, dorsolateral sclerites of segment 9 with 4 dark setae near posterior margin; median seta larger than others. Small, lateral sclerite of segment 9 with several minute setae and 1 larger dark seta.

Ventral sclerites of segments 7 and 9 yellowish; covering setae light, spinelike; setae at posterior margin strong, dark brown, 9–10 in each half of segment 8 and 12–14 in each half of segment 9; lateral, posterior-margin seta longer than others.

Laterodorsal plate of sclerite "b" of anal legs (Figure 727) yellowish, light, with a narrow, brown basal margin; surface of sclerite with short, dark setae; several longer setae in distal part; a row of short, brown, sparse setae dorsally; 7–9 dark setae of varying length above base of articular rods; 2 primary setae longer than others; 18–29 setae of apical fan thin, golden brown; a small sclerite near margin with long, brown, basal seta. Sclerite "c" triangular, brown, with a strong, long, dark brown seta which reaches end of claw.

Claw (Figure 728) brown, thinner and longer apically than in Hydropsyche; outer setae 2 and 6 and median setae 1 and 3 of the same length; seta 4 and seta 5 short, thin; setae 7 and 8 light; seta 7 small; seta 8 reaches end of claw.

(516)



FIGURES 727 and 728. Cheumatopsyche lepida Pict.:

727 – left anal leg, apex; 728 – claw of left anal leg, outer view (A) and inner view (B).

**Pupa.** Length of female pupae 6.0—6.6 mm, of male pupae 5.8—6.3 mm. Antennae of female pupae reaching segment 9, antennae of male pupae not coiled, slightly longer than body. Labrum with numerous, upward-directed, golden brown setae; primary setae not so much longer as in Hydropsyche. Anteclypeus with lateral tufts of setae like those on labrum.

Mandibles thinner than in Hydropsyche; left mandible with apical tooth and 4 other teeth, right mandible with 3 teeth; denticulate part of mandible with fine serration. Outer primary setae situated about in the middle of the apical part, thin, golden brown; a tuft of strong golden brown setae ventrally near base.

Wing sheaths tapering, pointed, reaching abdominal segment 6. Natatorial setae present on first 3 tarsal segments and partly on 4th segment of midlegs.

Presegmental plates present on abdominal segments 2—8, postsegmental plates on segments 3 and 4; number of spinules much smaller than in Hydropsyche. Postsegmental plates of abdominal segment 3 rounded,
516 with a few pointed spinules; postsegmental plates of segment 4 broadly elliptical; spinules form a transverse row in middle; spinules of presegmental plates of segments 5 and 8 situated on sides of sclerites; their number as follows: II:4—5; III:4—6+ 15—20; IV:3—4+ 6—12; V:2—3; VI:2—3; VII:3; VIII:2—3.

Pupal gills less numerous than in Hydropsyche; number of filaments of ventral gills given in Table 24.

(515) TABLE 24

| Segment | Intermediate | |
|---|---|---|
| | lateral | median |
| 2 | 7 | 7 |
| 3 | 8 | 8 |
| 4 | 8 | 8 |
| 5 | 5—8 | 3—7 |
| 6 | 4—6 | 4—5 |

Pleural teat-shaped gills large, with a wide base and long, thin end, present on segments 3—7; segment 3 with 1 gill; segments 4—7 with 3 gills situated one behind the other.

Genital appendages of male pupae curved, pointed, not contiguous.

Pupal case about 8—10 mm long, built of sand grains or small stones and fragments of plants, roots, leaves or wood.

517 Mode of life and habitats. Rivers and rivulets, mainly in foothills, on stony bottom, bottom covered with pebbles or on solid sand bottom. The larvae are known from the Southern Bug, Dnieper; rivulets of the Psekups, Zanga, Rion, Araks; rivulets on the Kola Peninsula, and the Varzob River in Middle Asia.

Distribution. Northwest, west, southwest and south of the European USSR, the Caucasus, Middle Asia. In addition, Europe, Iran, North Africa.

## 2. Subfamily MACRONEMATINAE Ulmer

**Full-grown larva.** Larvae have a different form from those of Hydropsychinae. Head broad, markedly flattened, with a characteristic chaetotaxy of different form.

Labrum oblong, with a more complicated chaetotaxy than in Hydropsychinae. Mandibles massive, sometimes long; left mandible without brush. Submentum of different form, with lobes at the anterior margin.

Median black spot at posterior margin of mesonotum small, sometimes mushroom-shaped or dot-shaped; median spot of posterior margin of metanotum in the form of a dot or absent. Trochantin of prothorax without basal horn-shaped process, conical or spear-shaped. Basal seta of claw of legs (with rare exceptions) in form of a short, thick, blunt spine; 2 or several small spinelike processes near seta. Ventral sclerites of segment 8 absent, ventral sclerites of segment 9 small and oblong.

Fan-shaped apical tuft on anal legs absent, replaced by 2 or 3 setae.

**Pupa.** Antennae long, coiled around posterior end of body. Anal legs narrow at the end, sometimes pointed. Pupae living in long tubular, jug-shaped cases attached at anterior end of substrate. They sometimes occur in large numbers, forming a crust, closely contiguous with their lateral walls.

Mode of life and habitats. Large rivers in the plains; larvae known from the Ob, Irtysh, lower reaches of the Biya, Yenisei, Angara, Stony Tunguska, Amur, Ussuri and their tributaries.

Distribution. Southern part of the USSR and Eastern Siberia, Amur Region, Maritime Territory. In addition, Asia, Africa, South, Central, North America, Australia, mainly in the tropics and subtropics.

### Key to Genera

Full-grown larva

1 (4). Head flattened dorsally, with a horseshoe-shaped ridge. Blades of mandibles with basal and apical teeth. Process of trochantin of prothorax conical. A conical process near base of fore coxae. Metanotum with a small spot in middle of posterior margin.

2 (3). Larvae large (20—22 mm); head broad and short; dorsal ridge sharply marked, with a crown of secondary setae; submentum trapezoidal . . . . . . . . . . . . . . . . . 3. **Macronema** Pict. (p. 592)

3 (2). Larvae much smaller (12—14 mm); head less broad; dorsal ridge without crown of setae; submentum triangular . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4. **Amphipsyche** McL. (p. 604)

4 (1). Head moderately long, not flattened dorsally, without ridge or secondary setae. Mandibles long; teeth of mandibles present only apically. Process of trochantin of prothorax spear-shaped. Fore coxa without basal process; metanotum without posterior median black spot . . . . . . . . . . . . . . . . . . 5. **Aethaloptera** Br. (p. 617)

## 3. Genus **Macronema** Pictet

**Full-grown larva.** Length 20—22 mm. Head flattened dorsally, with a horseshoe-shaped ridge with a crown of numerous strong, long secondary setae. Anteclypeus with transverse sclerites. Submentum trapezoidal. Process of trochantin of prothorax conical. Tibia and tarsus with a dense brush of thin, light, hairlike setae. Anal legs relatively long.

Mode of life and habitats. Building capturing nets, living on bottom of rivers. They feed on microplankton, according to Sattler (1963).

518 Distribution. Ob, Yenisei and Amur basins in the USSR. In addition, Asia, America (mainly South America), Africa and Australia.

### 1. **Macronema radiatum** McLachlan

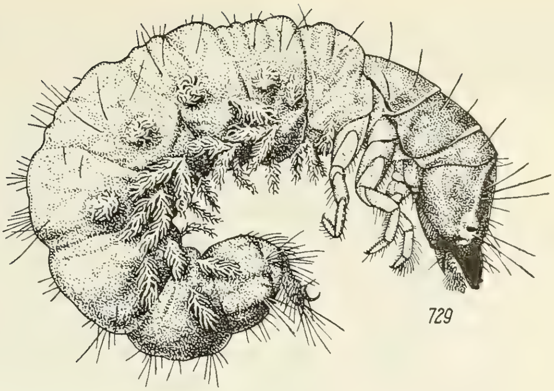
Lepneva, 1947:142—147, Figures 1—16; 1960a:175—178 (Figures 1 and 2).

**Full-grown larva.** Length 20—22 mm (Figure 729). Head broad, flattened dorsally on frontoclypeus and adjacent parts of lateral sclerites bordered by a ridge (Figure 730); frontal sutures (unlike in Hydropsyche) with lateral curvatures in region of tentorial pits. Large spots near ridge near posterior angle of frontoclypeus; these spots indistinct or slightly dark; similar spots lateral to sclerite posteriorly between frontal sutures and ridge, sometimes also posterior to ridge. All 3 anterior-margin setae situated close together in angles; lateral seta long, brown; intermediate setae short; median seta larger; both latter setae light and thin; a light secondary seta near margin of sclerite. Anterior frontal seta thin and small; a similar secondary seta further anteriorly in some specimens; middle frontal seta small, situated near suture, posterior to tentorial pit; posterior frontal seta slightly longer, situated near suture in region of posterior-angle spots. Surface of sclerite posterior to ridge and lateral to tentorial pits smooth and without chetae; other part of frontoclypeus and lateral sclerites surrounded by the ridge punctate because of presence of canal pores; these pores are funnel-shaped, with a curved, thin hair, sometimes 2 hairs, situated in them (Figure 731).

Seta 9 near the frontal suture, brown, longest seta of head; thin and short seta 11 situated near it; seta 7 smaller than seta 9, situated near dorsal articulation of mandibles; small light seta 10 situated anterior to eye; seta 16 situated near frontal suture, strong, brown and long near the spots; small, light seta 15 situated slightly anteriorly and laterally, near ridge. A row of 12—16 strong, brown, long setae situated laterally along ridge, among them several short and light setae and a ridge without setae posteriorly.

Ventral side of head with 2 rows of transverse dashes (Figure 734). Gula absent, but gular suture anteriorly curved laterally in some specimens, probably a trace of the margin of the gula. Seta 8 thin and short, situated near ventral articulation of mandible; seta 18 very small, situated in the posterior part.

Two brownish, transverse sclerites near posterior margin of anteclypeus; these sclerites divided by a narrow membranous stripe in the middle.



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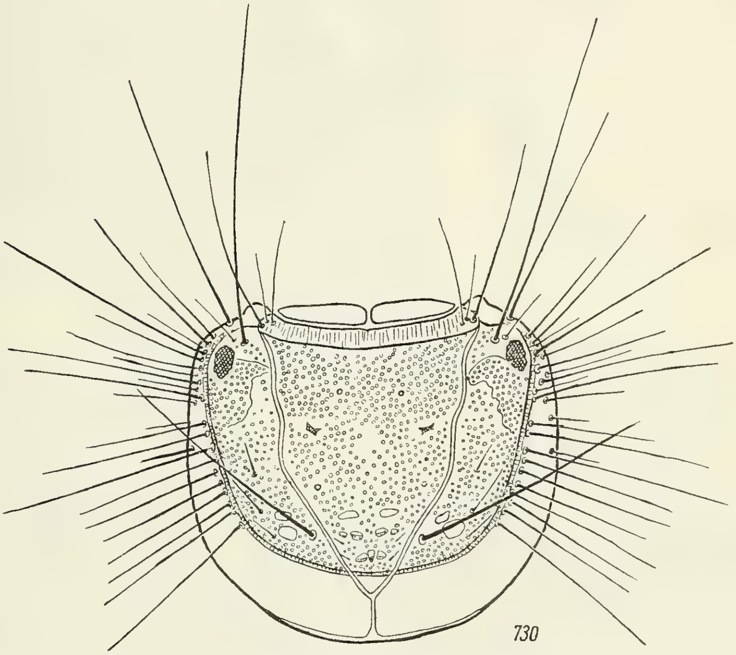

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FIGURES 729 and 730. Macronema radiatum McL.:

729 – full-grown larva; 730 – head, dorsal.

Labrum (Figure 732) broad; membranous, anterior margin well marked; dorsal sclerite golden brown, with a whitish, pointed median process which almost reaches membranous anterior margin; posterior-angle sclerites in the form of narrow, reddish brown rods. Anterior third of sclerite with large teat-shaped, blunt covering setae replaced by setae of different form in the middle near the margin; these setae are light, pointed, straight spines which form a tuft of dense, stronger, spear-shaped chetae at the apex of the process; small, thick, hooked spinules near base of posterior-angle sclerite.

Anterior-margin rows of dense, dark, curved, setuliform hairs on membranous part of labrum; posterior-angle tuft situated on a membranous process, consisting of similar dark hairs; these hairs are longer, directed ventrally and forming a fan in live larvae. Primary seta 1 situated in middle, indistinct; (520) seta 2 small and light; seta 3 relatively large and brown; setae 6 situated lateral to median pit, straight and relatively large; setae 5 situated anterior to them, large.

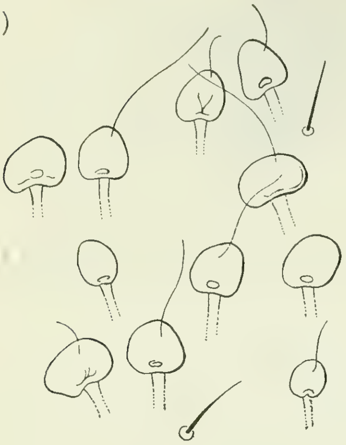


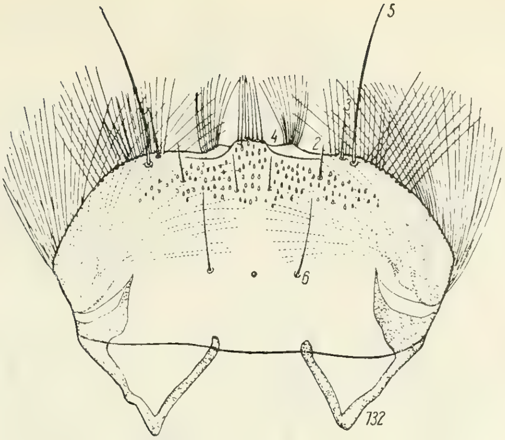
FIGURE 731. Macronema radiatum McL. Detail of the punctate surface of the head

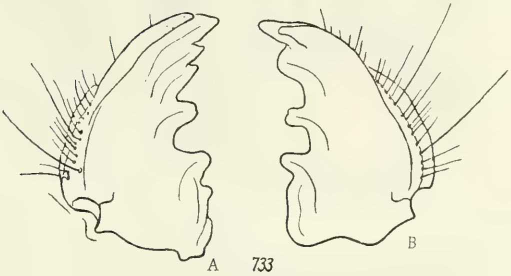
Mandibles massive, dark brown (Figure 733), moderately long; ventral side convex, dorsal side concave; upper, outer margin of basal part projecting like a wing; when mandibles are folded, this margin forms a continuation of the dorsal ridge. Upper blade of left mandible with a large apical tooth; lower blade with 4 large teeth in the apical part and 2 in the basal part. Upper blade of right mandible with 1 blunt apical tooth, lower blade with 3 large teeth in apical part and 1 in basal part. Broad outer margin of mandibles with numerous, short setae mainly in the part contiguous with the upper margin; 2 primary setae among them: 1 in middle of mandible and the other further basally.

Submentum (Figure 735) brown, irregularly trapezoidal, with slightly concave anterior margin; anterior and posterior angles rounded; 5 light,
519 thick, soft setae of different size (including a primary seta) laterally on anterior part near margin; the 2 lateral setae of this group shorter and thinner; 2 middle setae much longer than the others; medial seta curved inward. Cardo slightly longer than submentum, yellowish brown, with a dark brown basal margin; 8 or 9 thick, relatively long setae situated on outer side; several, small, thin setae among them. Stipes pale, yellowish brown at the outer margin and in the middle, with a basal group of long setae; setae in apical group shorter and fewer; a membranous median tubercle
520 with a tuft of numerous thin setae. Palpifer long; the distal primary seta longer; light, hairlike, dense setae in middle of membranous margin. Second segment of maxillary palps shorter than 1st and 3rd segment; last segment almost as long as 3rd segment. Galea narrow, adpressed to palp, with relatively long setae and rods.

Mentum dark brown; anterior margin with a small median indentation. Labial palps situated at margin of labium.

Pronotum (Figure 736, A) of characteristic form, short in the middle; a narrow, dark margin laterally and posteriorly; distinct grayish spots in a curved row in middle of each half; 3 small spots near posterior margin. Sides of anterior margin with short, light setae; similar, but slightly longer, setae laterally in anterior third; a long brown seta in the anterior angles; 3 setae (2 relatively long, brown setae and 1 short, light seta between them) in the middle of each half.





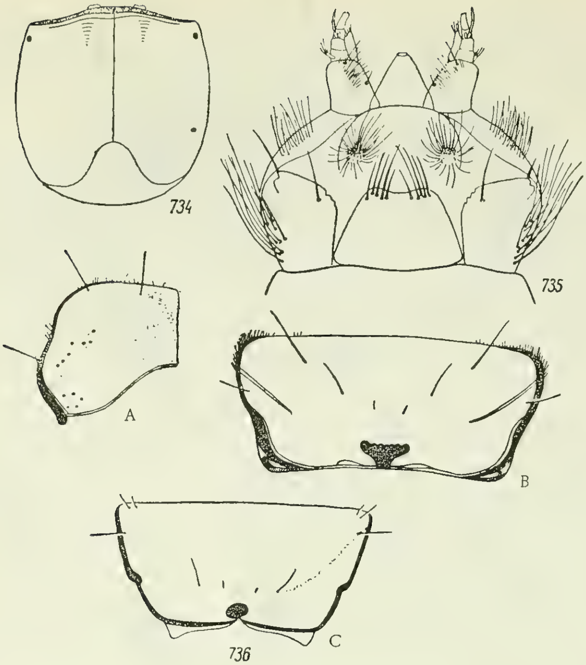
FIGURES 732 and 733. Macronema radiatum McL.:

732 — labrum, dorsal; 733 — mandibles, dorsal: left mandible (A), right mandible (B).

Meso- and metanotum (Figure 736, B, C) yellowish; mesonotum slightly broader than metanotum; each half of both segments with a dark, oblique stripe and brownish gray, large dots; anterior angles of mesonotum broadly rounded, with narrow, dark brown margin; lateral margin and posterior angle also narrow, dark brown; median black spot at posterior margin of mesonotum mushroom-shaped; spot of metanotum dot-shaped. Anterior margin and surface of sclerites with sparse, small, light chetae. Anterior-margin primary setae situated near margin, longer on mesonotum than on metanotum; medioanal setae situated near end of oblique stripe; a short, brown seta anterior to stripe; 2 similar setae posterior to it.

Propleuron large; pleural suture golden brown; episternum smooth, occupying greater part of pleural region; epimeron much smaller, with rounded posterior margin; a row of small, transparent, spinelike setae parallel to pleural suture; primary seta situated in middle of row among 2—3 longer setae. Process of trochantin conical, with teat-shaped, membranous end and 2 relatively large setules on outer side; a small primary seta situated basally; small, light chetoids near it and in other places.

The sternite consists of a thin, brownish plate with a narrow, membranous median suture; process of epimeron present anteriorly and laterally on sternite.



FIGURES 734–736. Macronema radiatum McL.:

734 – head, ventral; 735 – maxillolabium; 736 – nota of thorax: pronotum, left half (A), mesonotum (B), metanotum (C).

Legs (Figure 737) differing little in length; midlegs slightly shorter and thinner than hind legs; forelegs more massive. Ratio of length of legs 80:100:104.

Fore coxa with a shallow distodorsal indentation; a conical process with a black spot at the base, which bears a long anterior primary basal seta; dorsally a short, spinelike, light seta near anterior indentation; 2 brownish setae near apex of indentation; several, brownish, large setae on anterior surface of coxa in basal part and subventrally; several of these setae long; a dark, massive process is situated distally, in anterior part, near articulation with trochanter; short, light setae and 6 or 7 long, brownish setae, one of which is the primary posterior seta, dorsally, at the margin of indentation and near it; 5 or 6 relatively long, brown setae on posterior surface, in middle of segment and subventrally; small, light, covering spinules in subdorsal and subventral region; similar light spinules on ventral side, but they are more dense; a long, primary, posterior seta and several short, strong, light and dark setae (including the anterior primary seta) in distoventral part.

Five thin, long subventral setae on anterior side of trochanter, in basal part; similar soft, white, long, hairlike setae on posterior surface, ventrally and subventrally; among them similar long, thicker, light brown primary (?) setae; primary posterior seta situated near distal margin; anterior part
521 of ventral side with a row of small, light spinules; a long, thin (primary?) seta near apical margin.

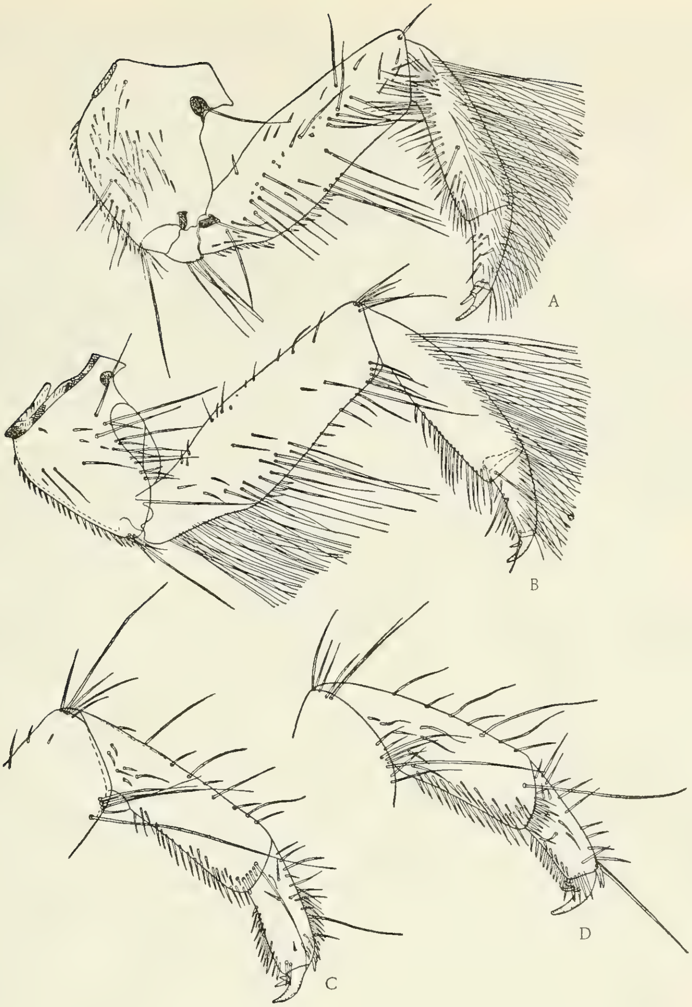


FIGURE 737. Macronema radiatum McL. Left foreleg, anterior (A), right foreleg, posterior (B), distal end of femur, tibia, tarsus and claw of right midleg (C) and right hind leg (D), posterior

Anterior side of femur with a massive, dark, hooklike process directed toward trochanter near articulation; dorsal surface with small, thin, sparse, light setae; larger basodorsal primary seta situated more anteriorly; distodorsal seta yellowish, several secondary setae near it; a longitudinal row of straight, relatively long setae on the anterior surface; 3 or 4 short, strong setae at distal end of row; ventral side of basal part with spinules like those on trochanter; short and long, strong setae on posterior surface of femur, subventrally in basal part; ventral side with long, dense, hairlike setae like those on trochanter; 2 long, brownish setae and 3 short setae ventrally near the apex; posterior primary, thin seta situated subventrally near apex; 2 secondary setae of almost the same length near it.

A remarkable character of the fore tibia is the presence of a dorsal brush of dense, thin, white setae continuing to the tarsus; the white setae become gradually shorter distally; similar setae situated on greater part of anterior surface of tibia, except on a narrow subventral stripe with sparse, short setae; posterior part distally with a brownish, primary, posterior seta; anterior surface of basal part with a group of soft, long setae and several shorter setae; dense, light, spinelike setae situated ventrally and subventrally in the anterior part near basal margin; these setae become longer distally.

522 A brush of white, thin setae covers tarsus dorsally and part of anterior and posterior surface; distodorsal seta light but shorter and stronger; several long, light, strong setae, including a thicker distal seta posteriorly, in area without hairlike setae, sparse, thick spines on anterior surface, 4 of them short and situated in basal part; 3 longer and situated subapically; 2 blunt, short, spinelike situated subdorsally and apically. Tarsus with a comb of short, thin spinules ventrally.

Claw blunt, slightly curved; apical part dark brown; basal seta thick, yellowish, blunt; a small tubercle on anterior side of basal part.

When the forelegs are extended anteriorly, a dense brush is formed of the thin setae of tibiae and tarsi and the thin setae of the trochanter and basal part of the femora.

Fore and hind coxae long; distodorsal indentation deep. Primary basodorsal seta small, spinelike, brownish, slightly longer on midlegs than on hind legs; anterior part dorsally with light and dark setae which are short or very small; anterior, primary, distodorsal seta long, brown; several straight, short or moderately long secondary setae near it; distal part with dense, short setae and a long primary seta dorsally; several sparse setae further basally; anterior and posterior surface of coxae with sparse, light, small covering setae; ventral side without setae; margin of coxa ventrally with straight, short and moderately long setae, 2 of which are primary setae; posterior primary seta slightly longer than anterior seta.

Basal part of trochanter without setae; apical part with light, stiff setae on anterior, posterior and ventral side; a brown, moderately long, primary
523 posterior seta on posterior surface; 4 of the 5 ventral primary setae long, yellowish brown; several secondary setae light and long.

Femur slightly concave anteriorly, convex posteriorly, with small, sparse, light setae and a moderately long, yellowish basal primary seta and a longer brown distal seta dorsally; several short, strong setae at apical margin. Small setae subventrally on anterior surface and near base; a short, primary anterior seta subapically; small setae posteriorly near base and subventrally; primary posterior seta situated subventrally, in a row of short and long setae at apical margin; ventral side with short, light setae
524 and 4 long, yellowish brown setae, including 2 primary and several long, light setae.

Tibia dorsally with short, light setae and 4 brownish, long setae, including both primary setae (except in a small, basal area); anterior surface with sparse, isolated setae; distal part with a long, primary seta subventrally; subventral region with 4 apical, short, massive, blunt, brownish spines situated close together on the posterior surface; a long, brown primary posterior seta dorsal to the spines; 2 rows of light, thin spines ventrally, obliquely arranged anteriorly, and longer posteriorly.

Mid-tarsi with a cover of dense, light setae on dorsal side and partly on anterior surface; these setae are stiff, less dense and less long than on fore tarsi; a long, brownish primary seta in the apical part; dorsal side with 2 long, yellow, more widely separated setae further basally; a light, long seta further basally; posterior surface subdorsally with spinelike, light setae which are slightly longer in basal part and form short, blunt, light spines in the apical part; 4 yellowish, thick, strong, pointed spines subventrally near apical margin, 2 of them longer; ventral side with 2 rows of short light, strong, pointed spines; these spines are sparse, short, obliquely arranged and almost curved to posterior surface; they are thin, larger and slightly inclined anteriorly. Fewer setae on hind tarsi; dorsal side of hind tarsi with sparse, light setae and 4 longer setae, including a brownish distal seta; light, spinelike setae subdorsally, anteriorly and posteriorly; a mediolongitudinal row of sparse, strong setae anteriorly; apical seta larger than the others; posterior surface with similar setae in basal part and 1 seta in apical part; 4 massive, brownish, spinelike setae subventrally near apical margin; 2 rows of spinelike setae on ventral side; they are thick and obliquely arranged in posterior part, thin and slightly longer in anterior part.

Claw strong, dark brown; basoventral seta blunt, massive; 2 spinelike processes, which are larger on hind legs near seta.

Thoracic and abdominal gills consisting of a stalk with simple filaments. Mesothorax with a pleural gill with 27 filaments near the legs; metathorax with 2 gills, 1 near the leg, with 25 filaments, and the other on ventral side, with 18 or 19 filaments.

Abdominal segments 1 and 2 markedly shorter than others; segments 4–6 longer; segment 8 strongly convex dorsally, covering segment 9. A shallow, indistinct fold at sides of abdominal segments 2–7; segments 2 and 3 with 2 pleural gills and segments 4–7 with 1 pleural gill dorsal to this fold; ventral gills arranged in 2 rows, a lateral and a median row; lateral row with 2 gills on segments 1–5 and 1 gill on segments 6 and 7; median row with 1 gill on segments 1–6.

The number and arrangement of gills and number of filaments shown in Table 25.*

TABLE 25

| Segment | Pleural | | Ventral | | |
|---|---|---|---|---|---|
| | | | lateral | intermediate | median |
| Mesothorax | 27 | – | – | – | – |
| Metathorax | 25 | – | – | 18 | – |
| 1 | – | – | 25+30 | – | 27 |
| 2 | – | 14<br>29 | 33+41 | – | 31 |
| 3 | – | 10<br>25 | 22+23 | – | 27 |
| 4 | – | 23 | 25+31 | – | 25 |
| 5 | – | 24 | 20+32 | – | 24 |
| 6 | – | 19 | 25 | – | 26 |
| 7 | – | 24 | 18 | – | – |

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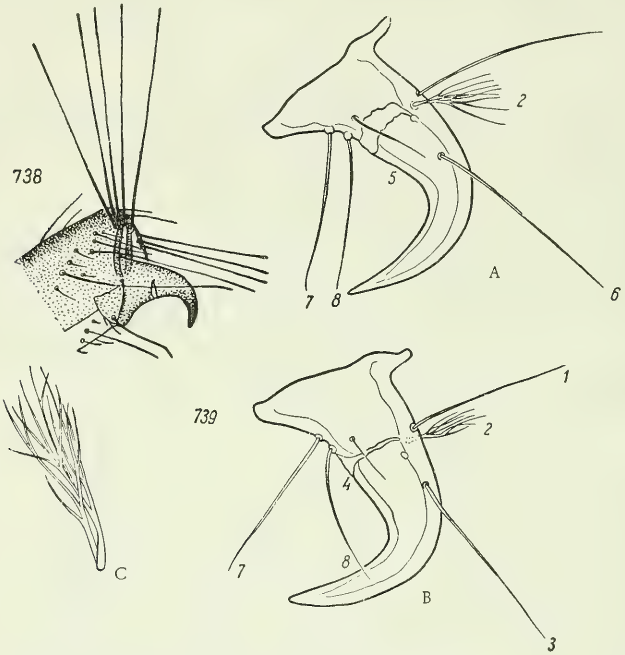
* Number of gill filaments variable.

Covering setae of abdomen of the same type reddish brown, small, sparser than in Hydropsyche, curved to surface; unlike in Hydropsyche, their base is very narrow; they are thin and pointed; blunt covering setae absent. A remarkable character of the larva is the presence of thicker and darker areas bordered laterally by rows of dense covering setae on the dorsum of 525) segments 6—8; these areas are rudiments of tergites and cover almost the whole dorsum; they resemble the sclerites of meso- and metanotum; they have similar, almost straight, anterior angles and broadly rounded posterior angles; integument of these scleritelike areas soft but thicker than integument of other parts of segment.

Primary and secondary setae dark and light; most secondary setae small, projecting; several setae dark, longer and thicker than the others; 2 such setae in the anterior angle, 1 situated laterally, 1 (or 2) in the posterior angle; posterior part of segment with 3 (sometimes 4 or 5) short, thin, brownish setae (such setae absent on segment 8). Unlike in Hydropsyche, ventral side of segment 8 without brown, triangular sclerites with long covering setae.

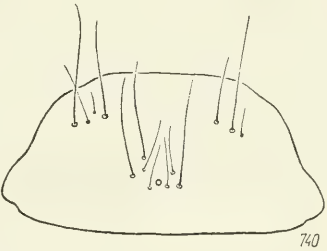


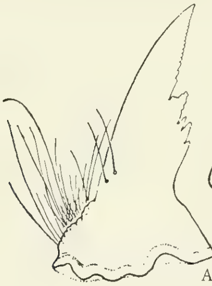
FIGURES 738 and 739. Macronema radiatum McL.:

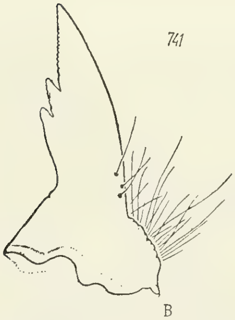
738 — apex of left anal leg, outer view; 739 — claw of anal leg: left claw, outer view (A), right claw, inner view (B); seta 2 of claw of anal legs (C).

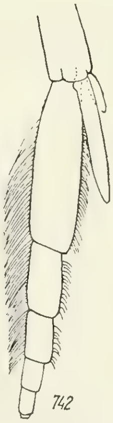
Small segment 9 very narrow anteriorly, covered by the process of segment 8, broader posteriorly, forming base for the anal legs; dorsal surface slightly thickened; its greater part without covering setae; posterior margin sclerotized, with a narrow stripe of small, reddish brown covering setae; a long, dark, medioanal seta laterally and 2 light setae near it; 2 long dark setae laterally and posteriorly. Sides of segment with a dense, longitudinal group of numerous setae in the pleural region; outer longitudinal row of setae of anal legs is a continuation of this group. Transverse anal slit with 5 light, anal gills. Ventral side with triangular, yellowish sclerites as in Hydropsyche; however, these sclerites are smaller and bear light, strong setae, which are long posteriorly.

Anal legs (Figure 738) small, short, smaller than in Hydropsyche; claw moderately long. Laterodorsal sclerite of section "b" yellowish brown, shining, smooth dorsally, with several sparse, small covering setae in some 526 places; mediodorsal margin of sclerite without setae; a longitudinal group of long golden brown setae on outer side, in marginal lateral stripe from base to apex. The 14–16 similar setae medially on membranous surface reach apical margin of the leg; 6 thin, yellowish setae at the base on ventral side; 2 of these setae long; a row of 8–10 short, golden brown setae ventrally near outer margin; this row does not reach the base. One large, dark brown seta dorsally near base of the articular rods; 3 or 4 similar long setae lateral to these setae, on the outer side at apical margin and on a membrane at the place of the distal fan of Hydropsyche and Arctopsyche. Sclerite "c" brown, with a light, long, curved seta.









FIGURES 740–742. Macronema radiatum McL. Pupa:

740 – labrum; 741 – mandibles, dorsal: left mandible (A), right mandible (B); 742 – end of tibia and tarsus of midlegs.

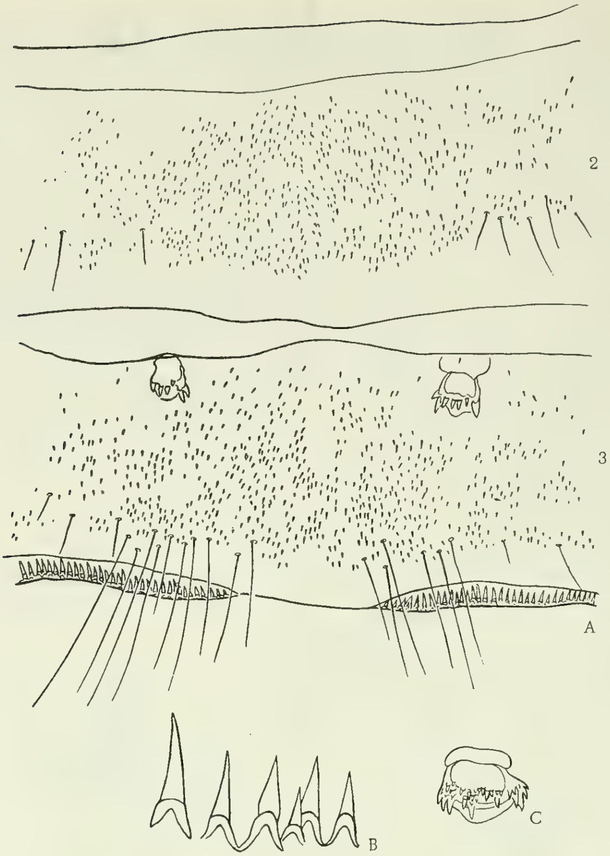


FIGURE 743. Macronema radiatum McL. Pupa. Holding apparatus of abdominal segments 2 and 3 (A), spinules of postsegmental plate (B), presegmental plate of segment 6 (C)

Claw (Figure 739) narrow, bent at a right angle with dark, pointed end. Seta 1 situated dorsally, light, whitish, moderately long, situated between basal and apical part; seta 2 also light, short, branched, situated near seta 1 (Figure 739, C); setae 3 and 6 situated symmetrically on sides, long and dark; short, dark seta 5 situated in basal part near the transverse stripe on outer side; the light, small seta 4 situated on inside; setae 7 and 8 light, curved; seta 8 slightly longer.

**Pupa.** Length 13–14 mm. Antennae longer than body, coiled around posterior end. Frontoclypeus anteriorly with strong, straight, golden brown setae which are thin and hooked at the end; anteclypeus brownish, with 7 or 8 thin, light yellowish setae. Labrum (Figure 740) small, yellowish, slightly sclerotized, curved ventrally, with thin, short, primary setae; 3 setae on each side near anterior margin, one of them larger than the others; 3 setae and 1–2 very small setae situated posteriorly in the middle. Mandibles (Figure 741) brown, slightly concave dorsally, convex ventrally, with pointed apex and with finely serrated blade; right mandible with 2 teeth, left mandible with 4 teeth, 2 of them large; broad base of mandible with a group of short, brownish yellow setae on the outer side of which the "primary" setae are slightly thicker and stronger.

(528)

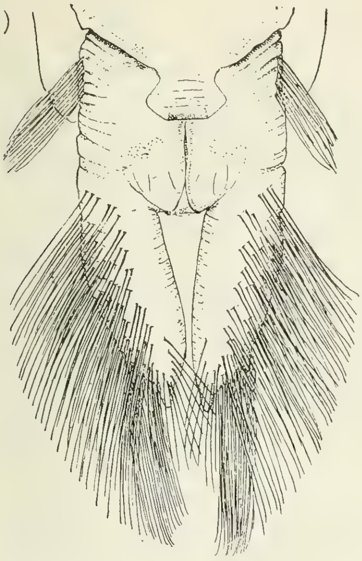


FIGURE 744. Macronema radiatum McL. End of body of male pupa, ventral

Wing sheaths reaching abdominal segments 5–6; hind legs reaching segment 8; natatorial comb of midlegs dense, present on tarsal segments 1–3; setae shorter on the ventral side, longer on the dorsal side (Figure 742).

528

Abdominal gills situated near posterior margin of the segments, ventral and pleural. Pleural gills larger than ventral gills on segments 2–7, flattened and conical near the base; cone continues into the stalk of the ordinary branched gill; number of filaments in pleural gills as follows: II:32; III:27–29; IV:23–24; V:20–22; VI:20–21; VII:18. Ventral gills of segment 2 with 3 stalks: 1 lateral and 2 median; ventral gills of segments 3–5 with 2 median stalks; ventral gills of segments 6–7 with 1 median stalk; base of the two median stalks situated close together; lateroventral gill of segment 2 situated at a distance from the 2 median gills; number of filaments in the ventral gills given in Table 26.

TABLE 26

| Segment | Ventral | |
|---|---|---|
| | lateral | median |
| 2 | 20 | 24+17 |
| 3 | – | 21+19 |
| 4 | – | 25+17 |
| 5 | – | 24+17 |
| 6 | – | 29 |
| 7 | – | 17 |

Presegmental plates (Figure 743) present on segments 3–8, postsegmental plates on segment 3; denticles large and small; number of denticles of presegmental plates listed in Table 27.

TABLE 27

| Segment | Denticles | |
|---|---|---|
| | large | small |
| 3 | 3–4 | 3–4 |
| 4 | 4–5 | 5–6 |
| 5 | 4–5 | 5–6 |
| 6 | 4–6 | 8–10 |
| 7 | 3–5 | 8–10 |
| 8 | 4 | 6–8 |

Postsegmental plates of segment 3 thin, narrow, with transverse rows of small spinules covering almost the whole width of each half segment (Figure 743,B).

Segment 9 with parallel sides; 18–20 thin, grayish setae laterally near the base. Anal rods convex laterally, narrower and hooked posteriorly; outer and ventral side with dense straight, strong, golden brown setae hooked at the end. Sheath of genital appendages of male pupae straight, oblique; penis sheath short (Figure 744).

Pupal case of varying form depending on conditions of pupation; when larva pupates alone (rarely), the case forms a slightly curved tube attached to substrate with margin of anterior end; this is closed inside by a convex operculum with holes; posterior end of tube rounded, with small holes; when tube is attached to an object, especially the tube of another pupa, no wall is built at area of contact, and a larger or smaller ventral slit is left; in this case, anterior and posterior end of slit always situated a distance from the anterior and posterior margin of the tube, so that pupal case is always tubular anteriorly and posteriorly.

Mode of life and habitats. Larvae build capturing nets; live in large (Amur) and small rivers, on solid bottom, mainly on stony bottom. Widely distributed in the Amur and its tributaries (Ussuri, Bikin, Khor); they occur in the Yenisei from the Minusinsk channel to the Stony Tunguzka; also in the Angara and Lower Tunguzka; they are known from the lower Biya and upper Ob in Southern Siberia.

Distribution. Eastern and Western Siberia, Amur territory, Maritime Territory in the USSR. In addition, Northeast China (Manchuria), Japan.

### 529 4. Genus **Amphipsyche** McLachlan

**Full-grown larva.** Length 10–11 mm. Head flattened dorsally in anterior part, with a horseshoe-shaped ridge which does not bear secondary setae; anteclypeus with short, transverse sclerites; submentum triangular; process of prothoracic trochantin conical. Brush of hairlike setae on tibiae and tarsi of forelegs present but less dense than in Macronema. Anal legs short.

Mode of life and habitats. Rivers.

Distribution. Amur basin in the USSR. In addition, China, Malacca [Malaya], India, Sunda Islands, Africa.

### 1. Amphipsyche proluta McLachlan

Lepneva, 1947:148–150, Figures 17–25; 1960a:178–181, Figures 4–5.

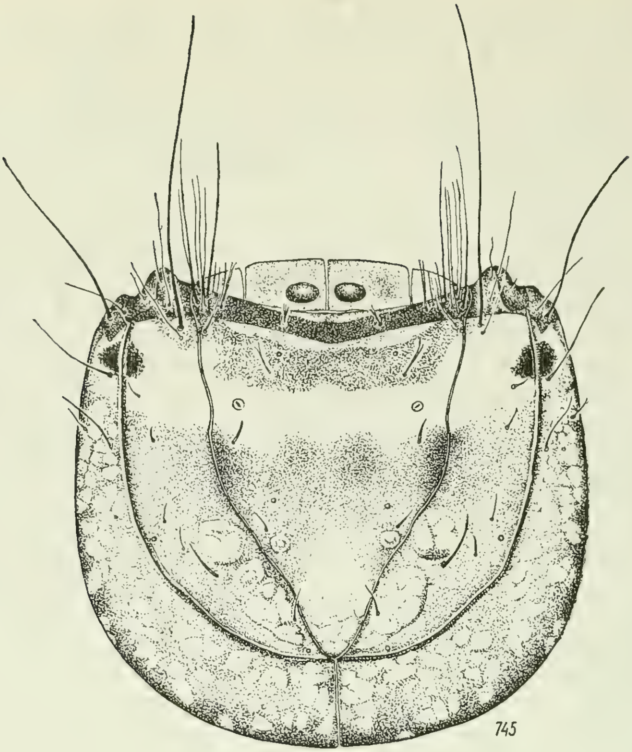
**Full-grown larva.** Length 10–11 mm. Color light, head slightly darker. Head and thorax much narrower than abdomen; maximum width of abdomen 2.0–2.1 mm on segments 4–6; width of mesothorax 1.1 mm, width of head 1.0 mm, length of head 1.1 mm.

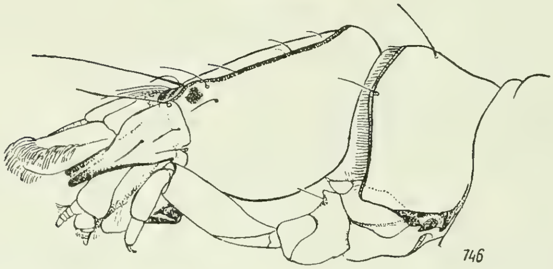
Flattened area of dorsal surface of head surrounded by a ridge, brownish (Figures 745 and 746) with a broad, transverse, light stripe in anterior part; other part of head yellowish. Frontoclypeus oblong-triangular, its posterior angle reaching the ridge; frontal sutures slightly curved in region of tentorial pits. Anterior margin of sclerite reddish brown; a narrow, yellowish stripe and a broad dark stripe posterior to it; posterior angle of frontoclypeus light, with large, indistinct, subapical dots; similar dots form 2 light groups in posterior part, lateral to frontal sutures. Surface of sclerite inside the ridge with small covering chetae which appear like light dots in preparations; covering chetae of frontoclypeus teat-shaped (Figure 747); teat-shaped, and hairlike chetae and chetae of transitional type with a broad base and long, thin end lateral to frontal sutures; also a few small branched setae with a short shaft; a star-shaped seta on each side, at anterior margin. Primary anterior-margin setae situated in angles of sclerite (Figure 745), situated close together, straight and thin; lateral of these setae yellowish and long; intermediate and median setae short; the same group also contains several light, long, secondary setae. Anterior, frontal seta small, thick; mediofrontal seta situated near tentorial pits, little marked; posterior frontal seta similar. Seta 9 dark brown, strong, longest seta of the head; thin, long seta 11 near it; several small secondary setae near clypangulus; seta 7 brownish, relatively long; small seta 10 situated lateral to the ridge, near the eye; setae 12, 13 and 14 situated behind each other posterior to eye; light short seta 15 and light longer seta 16 situated in posterior part, inside the ridge; 2 small, light, secondary setae anteriorly near eye; seta 17 short, slightly thickened, situated near suture.

Covering chetae absent on sides and ventrally; longitudinal rows of large transverse dashes laterally on ventral side (Figure 750); groups of large, slightly dark dots posterior to dashes, near occipital foramen; a narrow, dark stripe along suture; gular suture turning to the left anteriorly; gula not differentiated; postgula consisting of a small, shining, brown sclerite; seta 8 situated near anterior margin, thin and small; seta 18 with 2 branches small and situated in anterior third.

Anteclypeus with large, light brown, transverse sclerites with dark elliptical spots in middle; each sclerite divided by a suture into a large median part and a small lateral part.

Anterior margin and part of lateral margin of labrum (Figure 748) broadly membranous. Dorsal sclerite light brown, with small covering setae. Two tufts of thin, long, light hairs on each anterior angle on evaginated membranous lobes; anterior margin with a row of similar light but shorter hairs laterally. One of the primary setae (probably seta 5) situated at anterior margin, brown, longer and stronger than other primary and secondary setae on surface; dark median pit situated in posterior part.





FIGURES 745 and 746. Amphipsyche proluta McL.:

745 – head, dorsal; 746 – head and prothorax, lateral.

Mandibles (Figure 749) shorter than in Macronema; 1 apical tooth on upper blade of left mandible; lower blade with 3 apical teeth and 1 large, blunt, basal tooth with a small tubercle near its base. Right mandible with 1 apical tooth on upper blade, and 3 teeth on lower blade; basal part with 1 conical tooth and a thick, dark brown, blunt process at its base. Two
530 primary setae in middle of outer side; short, light, secondary setae along whole outer margin.

Membranous part of maxillolabium (Figures 750 and 751) white, sharply contrasting to shining, dark brown submentum, which is triangular in the middle, conical-convex, with rows of light setae laterally; primary seta thicker than others. Cardo light brown, with 6 or 7 long setae at base. Stipes narrow, pale brown, its setae numerous, forming a basal and an 531 apical tuft, longer in basal tuft. Palpifer yellowish, its distal seta strong; mediobasal seta small and light. Galea and maxillary palps brownish yellow, 4th palp segment almost as long as other segments together. Labium blunt; mentum brown, short, with a smooth, straight margin; labial palps rudimentary.

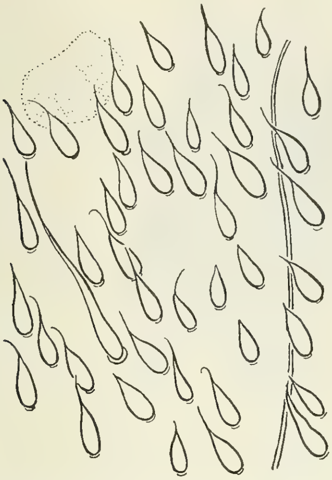
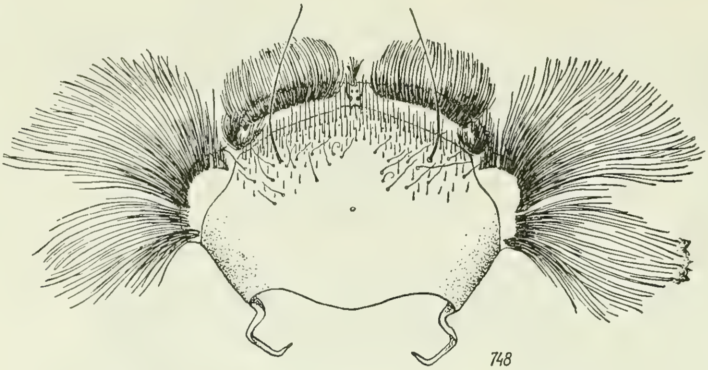


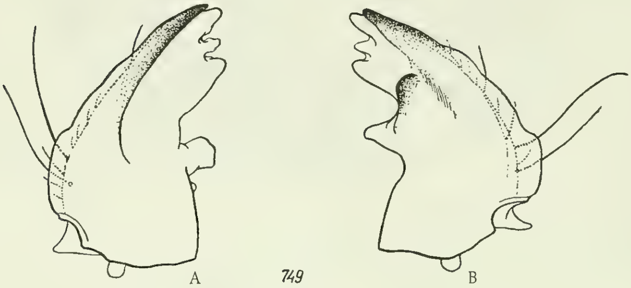
FIGURE 747. Amphipsyche proluta McL. Covering setae of head

Nota of thoracic segments (Figure 752) yellow, brownish yellow in some places. Anterior margin of pronotum with a broad median indentation and broad processes (Figure 752, A); anterior margin chestnut brown, with brownish yellow, strongly sclerotized anterior angles; lateral border like anterior margin in the anterior quarter, brownish black and broader posteriorly in its other part; posterior margin light brown, slightly darker in the middle; it consists of 2 stripes separated by a light space in its greater part; large groups of large, light spots laterally in each half of the sclerite. Light, small spinules at anterior margin; these spinules are larger laterally near the angles; a brownish, moderately long seta in middle of each half; 4 short, light setae lateral to this seta, at margin; 2 of these setae are situated in broad angle part of margin; surface of this part with several short setae (one of them near anterior angle) and several very small, light setae; 2 short setae laterally in this part and at lateral margin. Relatively long, anteriorly displaced medioanal primary seta, largest seta of the sclerite, situated in the anterior third at a distance from median suture; whole surface of sclerite (mainly in anterior half) with small hairlike, light covering setae and several larger setae which are simple or have 3 or 4 branches.

Meso- and metanotum (Figure 752, B, C) weakly sclerotized, light yellow; setae thin and light. Mesonotum broad, slightly shorter laterally; anterior margin smooth, mainly light, without border; a border is present only near the angles; anterior angles dark, reddish brown; border of lateral margin broad in middle, blackish brown; border of posterior margin narrow, yellowish, with white dots; median spot in form of a curved, dark reddish brown stripe with yellowish brown ends; oblique stripe on sides of sclerite brownish. Light part of anterior margin with dense small hairlike chetae; dark lateral parts with 9—11 strong, light, short setae; hairlike covering setae also on surface, mainly in anterior half, sparser posteriorly; 3 (sometimes 4) small, light, strong setae situated anteriorly, near margin; 3 similar small setae and several very small thin setae in anterior angle; medioanal surface seta long, almost reaching middle of segment; a 2nd large seta situated at a distance, closer to anterior third of sclerite; several not quite symmetrical, small, light setae along median line and on entire surface, among minute hairlike chetae; some of these setae are divided; 4 short, strong setae and several small setae along brownish, oblique stripe, 1 large seta near inner margin of stripe; a second seta situated near anterior angle.

(532)

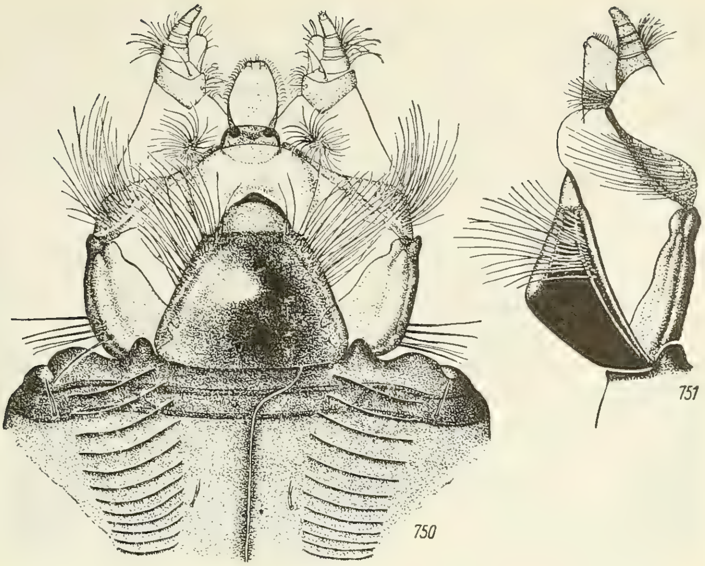




FIGURES 748 and 749. Amphipsyche proluta McL.:

748 – labrum, dorsal; 749 – mandibles, dorsal: left mandible (A), right mandible (B).

Anterior margin of metanotum completely light; anterior angles reddish brown; lateral margin narrow, brown in the anterior third and posteriorly; a broad, dark brown process in middle; posterior margin with a narrow, light brown border; posterior median spot situated at a distance before margin, small, reddish brown, with serrated anterior margin. Oblique stripes on sides of sclerite narrow, brown, with light or dark dots; similar large dots form several groups in each half of sclerite; 3 or 4 large, light dots in posterior part, lateral to median spot. Hairlike chetae of anterior row sparser than on mesonotum; 5 or 6 widely spaced, small setae on both
532 sides posterior to these chetae; hairlike chetae on surface of sclerite sparse in anterior third of sclerite; medioanal seta shorter than on mesonotum; a short, strong seta anterior to it, nearer anterior margin; small, sparse, light setae in region of forementioned chetae and along median line; several very small, light setae and 5 short, light setae along oblique stripe and on light space between stripe and lateral margin; one of these setae near posterior margin of stripe divided.



FIGURES 750 and 751. Amphipsyche proluta McL.:

750 — part of ventral surface of head and maxillolabium; 751 — maxillolabium, lateral.

Propleuron (Figure 753) wide; pleural suture forming reddish brown stripe; episternum without setae; setae of epimeron shorter and thicker than in Macronema; they form massive spines and spinules; a short, thin, primary seta, and 2 or 3 small setae near suture. Trochantin conical, shorter than in Macronema, with teat-shaped membranous apex; unlike in Macronema, strong, light setae present along whole dorsal margin; one of these setae thicker than others (primary seta?); ventral side with 2 subapical setules.

Sternite of prothorax forming a short, transverse plate which is yellowish brown posteriorly, whitish yellow anteriorly, and covers posterior half of ventral surface.

Meso- and metapleuron form a small, compact sclerite articulated with its dark reddish, brown ends to processes of coxa and notum, brownish black in middle; its dark, median spot has a small, pointed anterior process which represents the trochantin; it has 2 light setules at the end and a seta slightly further basally; seta of epimeron small, thin, situated near posterior margin.

Forelegs slightly shorter and broader than midlegs; hind legs of same form as midlegs but slightly longer. Legs yellow or yellowish brown.

533 Fore coxa (Figure 753) slightly concave anteriorly, convex posteriorly; as in Macronema radiatum, it has a basodorsal conical process and a dark spot near its base; distodorsal indentation deep. Anterobasal dorsal seta near the spot moderately long, strong, brownish; 2nd anterodorsal seta situated subapically, short, spinelike and brown; a row of thin, long, secondary setae at margin of indentation; primary posterior seta thicker

than others; 5 or 6 short, thick spines further apically; anterior surface with a large group of long, hairlike, whitish setae; a massive, blunt, reddish brown articular process dorsally; posterior surface with several small setae; 5 long setae in form of a fan, and 2 or 3 smaller setae near distal margin. Dense, small, pointed spinules ventrally; long, whitish, soft setae at ventral margin; these setae are the beginning of abundant, white hair cover on ventral surface of trochanter and femur.

(534)

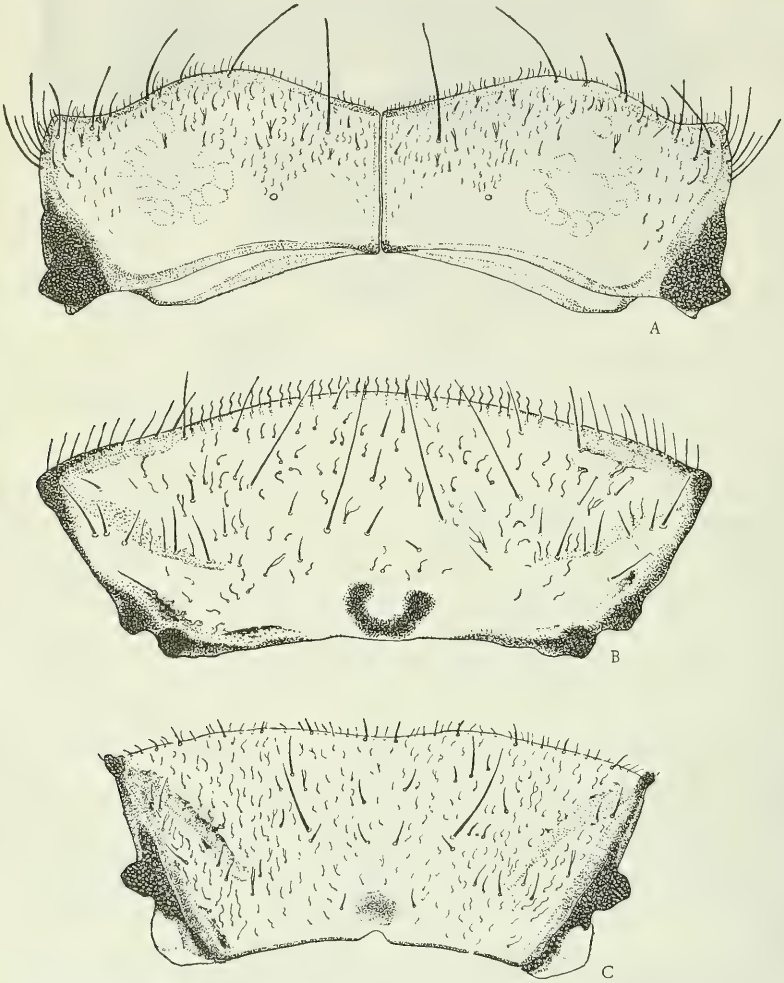
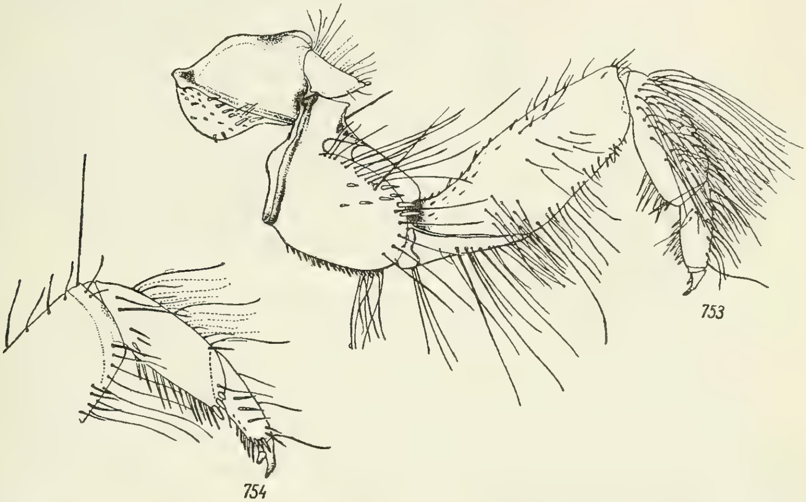


FIGURE 752. Amphipsyche proluta McL. Pronotum (A), mesonotum (B) and metanotum (C)

Basal part of trochanter with several light, long setae near the suture; primary anterior seta in apical part yellowish, strong, moderately long; short, dense, thick spines situated subventrally in anterior part, on whole margin and on part of surface; ventral side and posterior part with dense, light, soft, long setae, among which primary setae are indistinguishable, subventrally on the whole surface.

Apical half of femur anteriorly, dorsally and partly subdorsally with short, light setae; setae in basal part sparse and small; primary distodorsal seta short and yellowish; basal seta situated in middle of segment among secondary setae; basal part with several setae of varying length anteriorly; apical part with 3 or 4 short setae, one of which is the anterior primary seta; posterior surface with sparse, long setae and a basal group of long, thin setae; small, posterior, primary seta situated subventrally near the apex. Ventral side with numerous thin, light setae almost as long as those on trochanter; they are shorter apically; anterior and posterior sides with straight, strong setae, including several spinelike setae subventrally.

(535)



FIGURES 753 and 754. Amphipsyche proluta McL.:

753 – propleuron and right foreleg, posterior; 754 – apex of femur, tibia, tarsus and claw of right hind leg, posterior.

534 Tibia dorsally with a dense, continuous brush of light, long setae curved toward apex; similar setae on posterior side subdorsally and in basal part; anterior part subventrally with light, pointed spinelike setae; a row of similar spinules which are shorter toward apex situated on ventral side.

Dorsal side of tarsus with a row of thin, whitish, hairlike setae which are a continuation of brush of tibia; however, this row is shorter and sparser; similar setae posteriorly near base; several short, blunt, strong spines and a subapical short seta on anterior side; ventral setae forming 2 rows of light, short spines; a small, pointed, light seta situated ventrally near apex; a short, light seta situated subapically on both sides of row; a similar seta basally, on anterior side.

535 Claw of forelegs blunt, strong; basal seta forming a thick, light, blunt spine.

Hind and mid-coxae moderately long; their chaetotaxy less rich than on forelegs; basal primary seta situated anteriorly and dorsally small, light; apical primary seta long, brownish yellow, longer on hind legs than on midlegs; secondary anterior dorsal and subdorsal setae light, short or small; some of them thick or long, but shorter than primary setae; posterior primary dorsal seta thin, yellowish, long; several minute chetae near it. Anterior and posterior surface and ventral side with small, short, fine setae; long, light setae near apex ventrally and subventrally on anterior and posterior surface; 3 or 4 short, blunt spines on the midlegs subventrally in posterior part; similar, but very small, spines on hind legs.

Trochanter anteriorly and dorsally with a reddish brown stripe; dense, long, light setae on ventral surface, from apical margin of basal part, extending to part of anterior and greater part of posterior section; yellowish, subapical, ventral, primary seta well marked.

Dorsal and subdorsal secondary setae of femur short and light; primary basodorsal seta among them; primary distodorsal seta light, straight and long, longer on hind legs than on midlegs; a row of short setae and several long setae on anterior surface; these setae are fewer in number, smaller and situated mainly in the basal part on hind legs; a similar longitudinal row of setae on posterior surface of midlegs, slightly more ventrally; hind legs with sparse, small setae; posterior primary seta situated subventrally; subventral setae form short spines in anterior part; they are blunt and dark on hind legs, pointed on midlegs; long and short light setae ventrally and subventrally; they are dense on midlegs and situated along entire segment; they are sparser, mainly situated in apical half on hind legs, the 2 primary, ventral setae among them.

Tibia and tarsus of midlegs and hind legs (Figure 754) dorsally with thin, relatively sparse, light setae (unlike on fore tibia and tarsus). Primary distodorsal seta of tibia long on hind legs, slightly longer than distodorsal seta of femur on midlegs; short spinelike setae subventrally in anterior part; similar setae posteriorly near the base; 2 long setae among them on midlegs; other surface setae small, sparse, less numerous posteriorly than anteriorly; 2 small, blunt spines subventrally on the posterior surface, near
536 the apex; 2 primary, larger, pointed spines ventrally near the apex; a long seta, which reaches end of tarsus subventrally on anterior surface; ventral side with 2 rows of thin, short, light spines longer basally and shorter apically.

Primary distodorsal seta of tarsus straight, light, shorter than on tibia; other setae small, few in number; some setae longer and stronger than the others; ventral setae of mid-tarsus forming light, pointed spines, the apical spine larger and thicker than others; ventral spines of hind tarsus shorter and sparser; distoventral spine also large. Claws massive; seta forms a blunt, thick, short spine; 2 or 3 small, light, spinelike processes near the spine.

Mesothorax ventrally with a median gill consisting of a large stalk with 22 filaments; ventral gills of metathorax forming a median and a lateral row; median gill large, with 23 filaments, ventral, lateral gill with 18 or 19 filaments.

Abdomen of more or less uniform width in segments 1–8; segment 9 small, very narrow, its dorsal side covered with a fold of the posterior margin of segment 8. Abdomen with small setuliform covering setae as membranous parts of the thorax.

Dorsum of segments 1 and 2 with a narrow, yellowish brown, transversely elliptical figure which is light in middle and surrounded by small spinules with broad base and hooked, posteriorly directed apex; these spinules form a broad stripe; this elliptical figure resembles the elliptical postsegmental plates of segment 3 of the pupa of Hydropsyche; according to arrangement of spines, these ellipses resemble presegmental pupal plates; light middle of ellipse without spinules.

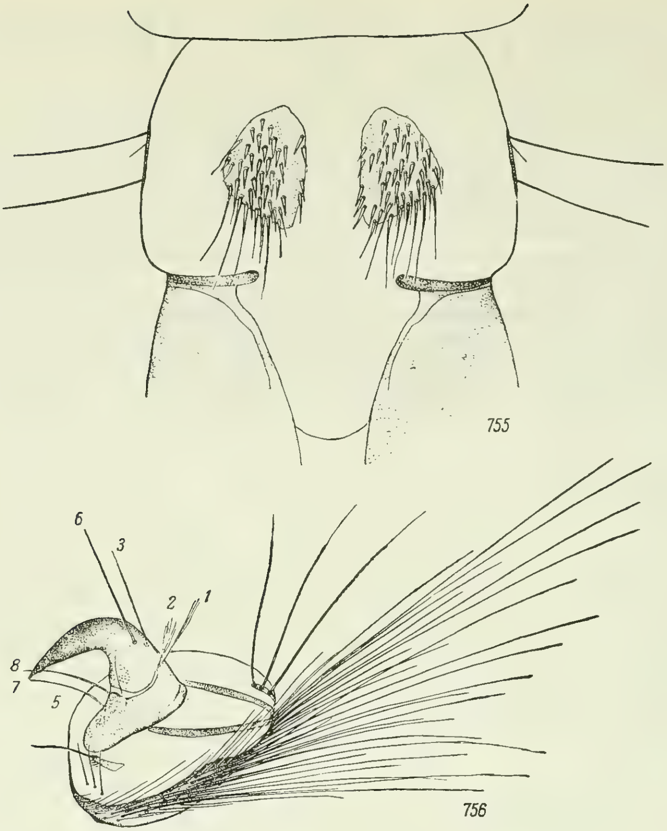
Gills arranged in 4 rows, 2 in pleural region and 2 in ventral region; ventral gills present on segments 1–8, pleural gills on segments 2–7 (Table 28); lateral, ventral gills with 2 branches, median gills with 1 branch; arrangement of gills and number of filaments shown in Table 28.

TABLE 28

| Segment | Pleural | | Ventral | |
|---|---|---|---|---|
| | subdorsal | subventral | lateral | median |
| Mesothorax | – | – | – | 22 |
| Metathorax | – | – | 19 | 23 |
| 1 | – | – | 11 | 10 |
| 2 | 14 | 15+12 | 14+12 | 16 |
| 3 | 16 | 12+11 | 13+12 | 12 |
| 4 | 17 | 12 | 14+10 | 13 |
| 5 | 16 | 12 | 12+10 | 10 |
| 6 | 12 | 12 | 10+10 | 11 |
| 7 | 10 | 10 | 8+8 | – |
| 8 | – | – | 13+10 | – |

Primary setae of abdomen thin, light, small, larger on posterior segments than on anterior segments. Anterior-margin seta small, situated a distance from anterior margin; anterior-angle seta larger than others, situated in about the middle on segments 1–7, near anal setae on segment 8; medioanal seta slightly shorter than anterior-angle seta; intermediate and lateral setae small, distinct only on segment 8.

Segment 9 small, narrow, its dorsal side covered by a fold of segment 8; grayish yellow, thin, rhomboidal sclerites dorsally on the sides; they have 4 setae near posterior margin: 1 seta displaced laterally and posteriorly; a brownish, long, anterior-angle seta and a similar, slightly smaller, medioanal seta between them; a small, light, branched, intermediate seta and a lateral branched seta, the former with 5 branches, the latter with 3 branches. Ventral side with thin, yellowish, triangular plates (Figure 755), covered with short, conical spines anteriorly; spines long with a long fine end in the middle; light setae with slightly thicker base near posterior and
537 lateral margin. Three brown setae on sides of sclerite; 5 anal gills.

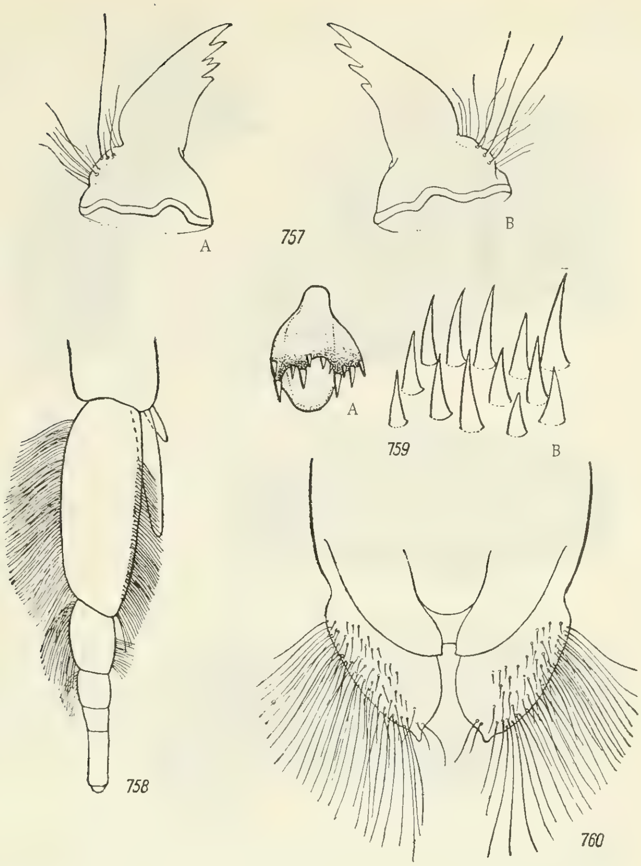


FIGURES 755 and 756. Amphipsyche proluta McL.:

755 — abdominal segment 9 and base of anal legs, ventral; 756 — right anal leg and claw, lateral.

Anal legs (Figure 756) short; dorsolateral sclerite of section "b" grayish yellow, with brown articular rods and a small apical process contiguous to rod and with 3 or 4 long, golden brown setae which are homologous to the "fan" of Hydropsyche; 1 seta near base of rods; the other setae at apical margin, shorter and thinner; similar setae ventrally and at lateral margin are long and more numerous in distal part; no setae on dorsal surface. Membranous surface of anal legs with a short, light, thick ventral seta near base; a group of 5—7 thin, golden brown setae in the middle. Sclerite "c" dark brown; primary seta strong and light; small, secondary setae, light, spinelike setae, and several small, blunt setae near its base.

Claw (Figure 756) brown, dark brown at the end; short, light, seta 1 situated in basal part near suture, with 3 branches; seta 2 slightly longer, light, situated nearby, with 5—7 branches; mediosubdorsal seta 3 brown and strong; large seta 6 situated subdorsally on outer side, shorter and thinner; basoventral setae 7 and 8 light; small seta 5 situated near seta 8, on outer
538 side; small spinelike seta 4 situated inward; both setae straight and light.



FIGURES 757–760. Amphipsyche proluta McL. Pupa:

757 – mandibles, dorsal: left mandible (A), right mandible (B); 758 – end of tibia and tarsus of midleg; 759 – plates of holding apparatus: presegmental plate of middle abdominal segment (A); spinules of postsegmental plate of segment 3 (B); 760 – end of body of male pupa, ventral.

**Pupa.** Length 8.5–9.0 mm; body slightly curved. Antennae light, much longer than body, with large segments (length 0.5 mm); antennae coiled 3.5 times around last abdominal segments. Eyes large. Long, straight, hooked setae on frons between the eyes. Labrum small, short, brownish, rounded anteriorly and laterally, with a transverse fold in anterior third; 3 thin, long setae situated close together on both sides and several short setae posterior to fold; lateral seta longer than others. Mandibles (Figure 757) brown; their apical part shorter and broader than in Macronema, boundary with basal part distinct; teeth of mandibles not serrated; in addition to the apical tooth, left mandible with 2 large and 2 small teeth; right mandible with 2 large teeth and 1 smaller basal tooth; outer primary
539 setae situated in basal part; apical seta curved to the surface, light; 2nd seta straight, brown;both setae are situated among shorter or light or brownish setae.

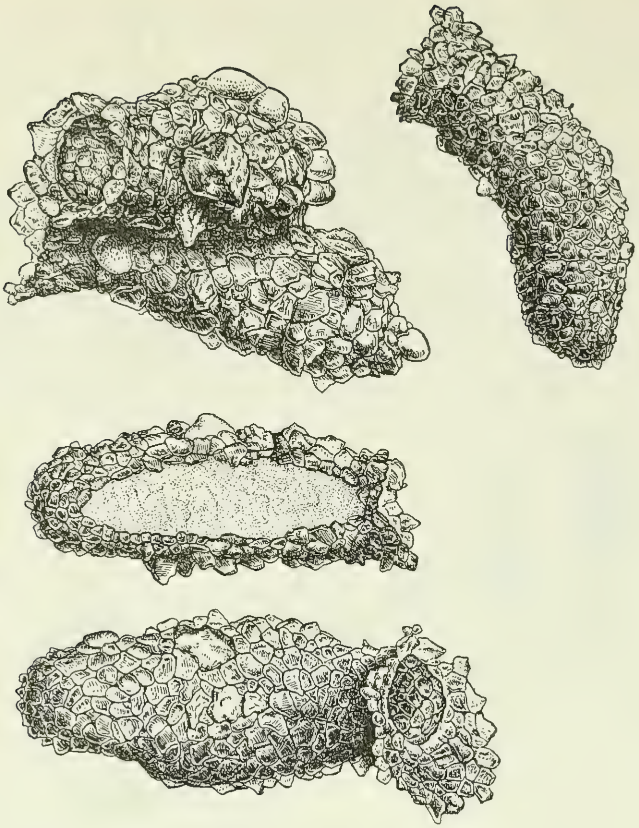


FIGURE 761. Amphipsyche proluta McL. Pupal cases

Sheath of fore wings reaching beginning of segment 5, that of hind wings shorter. First tarsal segment of midlegs long and broad, as long as 4 other segments together; natatorial setae present on segments 1 and 2 and a few setae on dorsal side of segment 3; dorsal setae longer than ventral setae (Figure 758).

Presegmental plates (Figure 759) present on segments 3–8; number of spinules as follows: III:16–19; IV:22–23; V:17–19; VI:19–20; VII:18–19; VIII:10–11; transverse rows of the 65–67 small, anteriorly-directed spinules near posterior margin of segment 3, in each half (Figure 759, B).

Gills present on segments 2–7, forming a pleural and 2 ventral rows (a lateral and a median row); pleural gills with posteriorly-directed, conical base with a long, apical branch which is curved dorsally on segments 2–7; stalks long, with 1 or 2 constrictions. Number and arrangement of gills shown in Table 29.

Anal lobes (Figure 760) short, with numerous strong, straight or hooked setae. Male genital appendages curved, penis sheath short.

Case (Figure 761) of isolated pupae forming a slightly curved tube without
540 ventral slit; it is attached to substrate at anterior end; free posterior end of

tube rounded and slightly broader; tube narrowed like a jug anteriorly, near place of attachment; a convex, round operculum in this narrow part; this operculum consists of 1 layer of sand grains. Pupae are found in large numbers, so closely situated together that the cases are deformed; there may be slits in the case walls, but these slits are closed by the walls of adjacent cases.

FIGURE 29

| Segment | Pleural | Ventral | |
|---|---|---|---|
| | | lateral | median |
| 2 | 23 | 15+12 | 18+14 |
| 3 | 24 | 13 | 18+14 |
| 4 | 21 | 13 | 19+11 |
| 5 | 17 | 14 | 12+10 |
| 6 | 14 | 15 | 12+10 |
| 7 | 15 | 14 | 12+10 |
| 8 | 15 | 15 | – |

Mode of life and habitats. Large rivers in the Far East (Amur, Ussuri, Bikin), in the main river and in tributaries, on solid bottom (Klyuchareva, 1952:364, 372–373).

Distribution. Far East (Amur basin) in the USSR. In addition, Northwest China.

## 5. Genus Aethaloptera Brauer

**Full-grown larva.** Head oblong, not flattened dorsally, without a ridge. Submentum with straight anterior margin and rounded lateral margins. Mandibles long; teeth displaced to apical margin; large basal teeth absent. Mesonotum with a small, median spot at posterior margin; metanotum with a small, median spot at posterior margin; metanotum without spot. Prothoracic trochantin with a long spear-shaped process.

Mode of life and habitats. Large rivers. The adults fly in large numbers above the water in summer.

Distribution. Amur and Maritime Territory, Eastern and Western Siberia in the USSR. In addition, China, Sunda Islands, India, Africa.

### **Aethaloptera rossica** Martynov

Lepneva, 1947:150–151, Figures 26–37.

**Full-grown larva.** Length 17–18 mm (Figure 762); abdomen of fixed specimens whitish; sclerotized parts yellow or whitish yellow. Head (Figure 763) without pattern; eyes small; frontoclypeus narrow, with small lateral indentations near tentorial pits; large, indistinct dots sometimes in posterior angles; anterior part of sclerite with a wide process. Primary anterior-margin setae brownish; lateral and median seta longer; intermediate seta situated slightly posteriorly, shorter and slightly thinner; 2 similar long, secondary setae medially; 2 light, short setae near frontal suture in angle and slightly posteriorly. Anterior frontal seta large, light, situated at level of seta 9; 2 small branched setae anterior to it; median frontal seta small, situated near tentorial pit; posterior frontal seta light, divided, smaller. Frontoclypeus and adjacent parts of lateral sclerites with thin, sparse, small, covering setae including hairlike branched setae. Seta 9 situated near suture, long, straight and brown; seta 11 small, light, divided, situated lateral to seta 9; seta 7 situated near margin of head, yellowish, moderately long; setae 14 and 12 situated posterior to eye, one behind the other; seta 12 much shorter than seta 14; setae 15 and 16 situated near suture, one of them long; seta 17 absent. Ventral seta 8 situated near anterior margin, light and strong; seta 18 is situated in posterior part, small; unlike in Amphipsyche, it is an ordinary seta and not divided.

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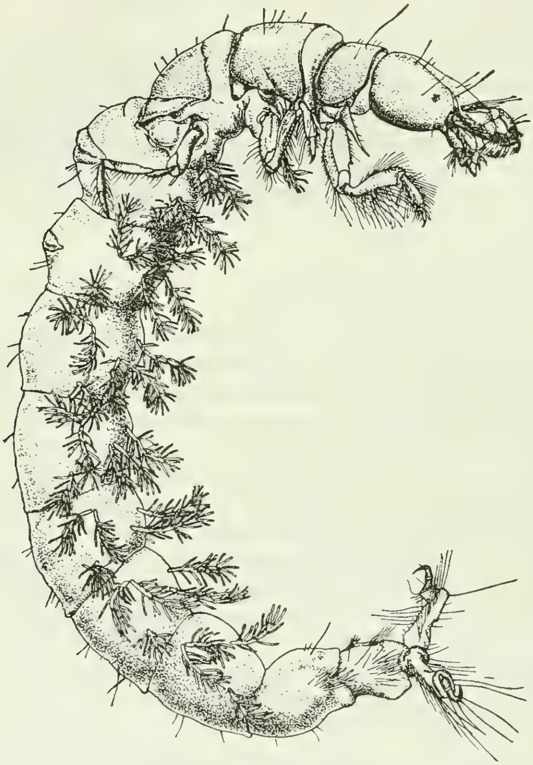
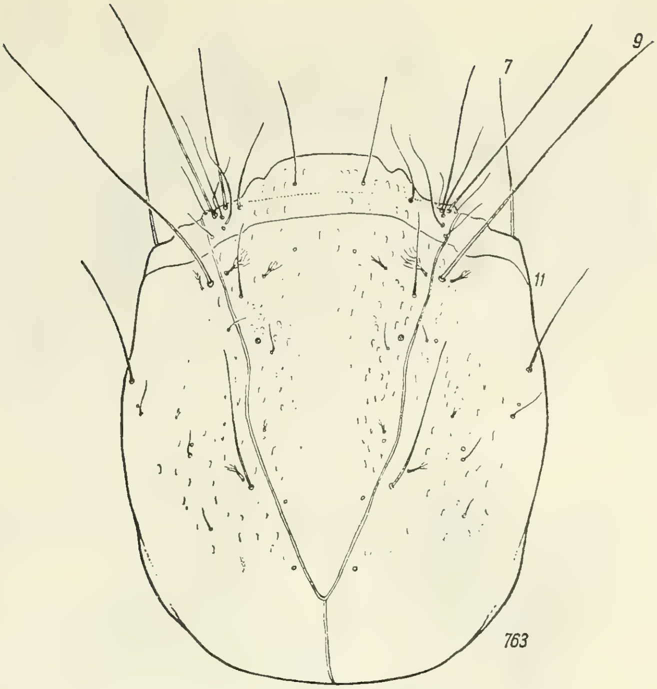


FIGURE 762. Aethaloptera rossica Mart. Full-grown larva, lateral



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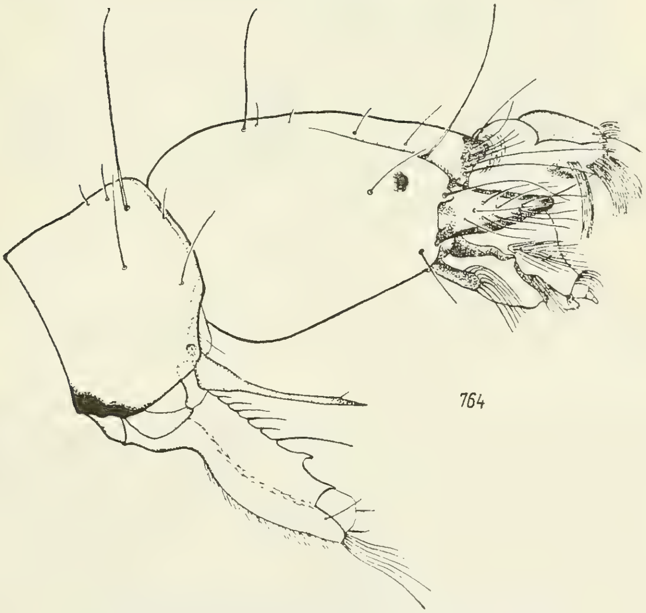

764

FIGURES 763 and 764. Aethaloptera rossica Mart.:

763 – head, dorsal; 764 – head, prothorax and coxa of foreleg, lateral.

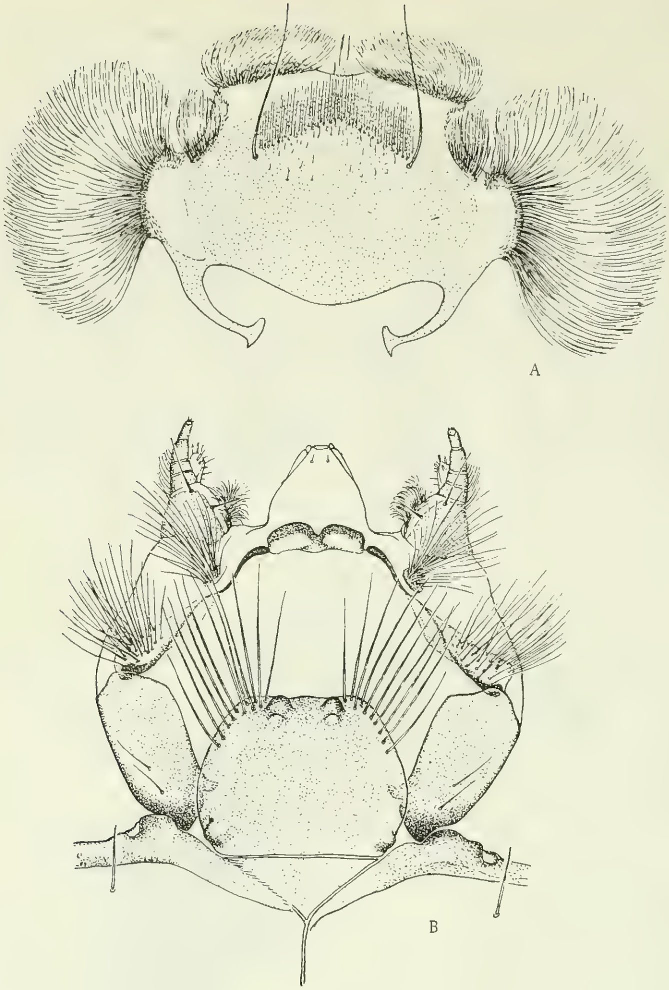

FIGURE 765. Aethaloptera rossica Mart. Labrum (A), maxillolabium (B)

Labrum (Figure 765, A) broadly membranous near anterior margin. Dorsal sclerite light brown, with rounded anterior margin; posterior-angle sclerites in form of narrow reddish rods. Straight, dense, light spines form a row on surface near margin with an angle in middle; similar light setae, but in smaller numbers, also on anterior membrane; only primary seta 5 large, brownish, situated lateral to row. Hairs at anterior and lateral membranous margin very dense; anterior groups of dense, yellowish, curved 541 hairs situated on 2 tufts of shorter hairs in anterior angle; lateral group, the largest, consisting of long curved hairs; small spinules near base of lateral group of hairs.

Mandibles long, curved inward near base. Left mandible with 2 small teeth on upper blade, near large apical tooth; 2 teeth of lower blade finely serrated; a wide, rounded process present instead of molar tooth. In addition to the apical tooth, right mandible with 1 tooth on upper blade and 2 teeth on lower blade; a rounded process basal to these teeth. Outer side of mandibles with numerous setae; 2 primary setae long and thicker than others on left mandible; 4 or 5 thick, long setae on the right mandible.

Gula triangular, fused with pregula. Submentum (Figure 765, B) rounded laterally with 2 dark tubercles anteriorly and 9–11 strong, long setae, including a primary seta, which is indistinguishable from others near the margin. Cardo yellowish, with 2 small setae near base. Stipes in form of a thin yellowish plate; tufts of numerous, thin setae basally and apically on a membrane near plate. Palpifer light yellow; 1 small seta distally and in the middle; palpal segments short; 3rd segment longer than others; galea short, narrower apically, with relatively large rods and setae. Mentum in form of narrow, dark band. Labium conical; ventral sclerites in form of dots with a small seta; palps rudimentary.

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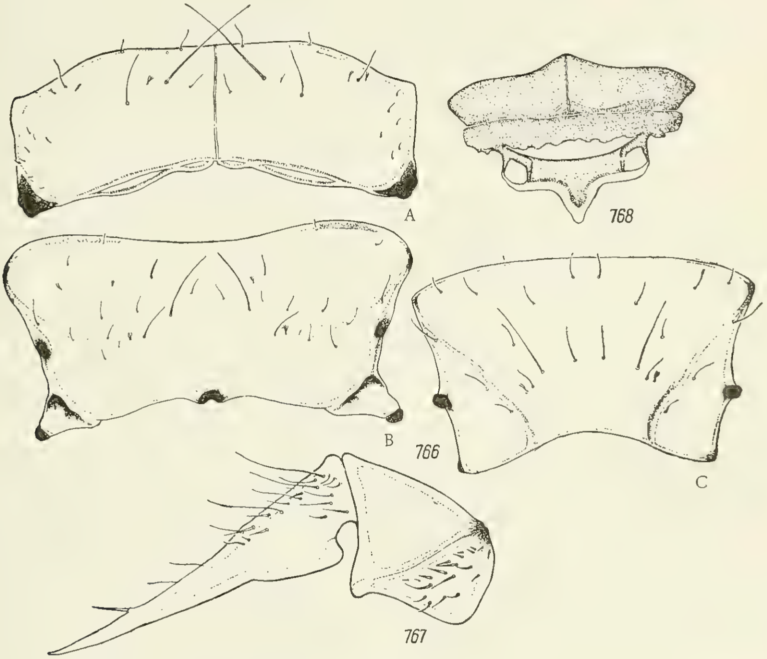


FIGURES 766–768. Aethaloptera rossica Mart.:

766 – dorsal setae of thorax: pronotum (A), mesonotum (B), metanotum (C); 767 – pleuron of prothorax; 768 – sternite of prothorax.

543 Nota of thorax light, without pattern. Pronotum (Figure 766, A) yellow, shorter than meso- and metanotum, with narrow, brownish anterior, lateral and posterior margin; anterior margin slightly concave in the middle; posterior angle black. Small hairlike setae at anterior margin, small, sparse, covering chetae on surface, larger, divided chetae among them. A small, thick seta anteriorly near median suture and in middle of each half;

a similar seta in anterior-angle region; a long, brown seta near anterior angle; a small, divided seta near this seta, slightly posteriorly; Surface setae displaced to anterior third; long, brown, strong median seta situated at distance from suture; a light, short seta further medially, slightly
544 posteriorly, near suture; a 2nd long, thin, brown seta laterally in middle of each half; a small 5-branched seta among the long, brown, surface setae; a small, light seta anterior to it; 3 small light setae in lateral part.

Mesonotum (Figure 766, B) pale yellow; only sides of anterior margin brownish; it surrounds rounded anterior angle; a small, dark brown spot near anterior angle; a black spot in middle of lateral margin; posterior angle separated from other part by a reddish brown stripe, posterior angle black; posterior margin narrowly yellowish; median spot small and black; oblique stripe of lateral region slightly brownish. Thin hairlike setae on anterior-margin laterally; each half of sclerite with 2 short thick setae, one in middle and 2nd in anterior angle; a small light seta posterior to each of these setae. A large, brown medioanal seta in middle of sclerite; 2 small setae near median line; a similar seta laterally and slightly anterior to medioanal seta; short, thin seta, 2 divided setae and 1 small, thin seta near base of oblique stripe; 3 setae posterior to stripe, the largest of them situated in corner near lateral border. Covering surface setae small and hairlike, as on pro- and metanotum.

Metanotum (Figure 766, C) slightly longer and narrower than mesonotum; anterior margin pale; anterior angle slightly dark; lateral margin narrowly dark, with a dark spot posteriorly; spot on posterior angle small; posterior margin with a narrow, yellowish border, without dark, median spot; oblique, yellowish brown stripe of lateral region extending to posterior margin. Anterior margin without hairlike chetae; 2 small setae in anterior angle; 1 thin seta in middle and 1 in middle of each half of the sclerite. Medioanal seta large, situated farther from midline than on mesonotum; 2 small, light setae situated anterior and inward to large seta; a thin, short seta and
545 2 divided setae near oblique stripe; 3 setae lateral to stripe; anterior seta of this group larger than other 2 and situated in angle.

Propleuron (Figure 767) with a narrow yellowish suture; epimeron curved posteriorly with several, short, thick, secondary setae and a primary seta. Episternum without setae; trochantin broad near base, with long spear-shaped process, and numerous short setae at base; primary seta situated in apical third of process, short, light and strong; both setules situated slightly more basally. Pleural sclerites of meso- and metathorax small, rodlike, with narrow episternum and epimeron, a black spot in middle.

Prothoracic sternite (Figure 768) consisting of an anterior and a posterior sclerite; anterior part of former whitish yellow, with a narrow, indistinct median suture; posterior part yellowish; posterior sclerite short, T-shaped, with concave, anterior margin which is laterally contiguous with anterior sclerite, and with short, posterior, beak-shaped, narrow, median part.

Legs brownish yellow. Fore coxa (Figure 769) strong, with a ventral keel and an anterior and a posterior ridge on dorsal side; the former is sharp with a large, dark brown, spinelike apical process; basal primary seta strong, brown; apicoanterior seta shorter; 2 or 3 long, light setae and several small secondary setae at dorsoanterior ridge; posterior surface with a long, brownish, primary seta, 7 or 8 short, spinelike dorsal setae and

2 or 3 subdorsal setae at the margin. Anterior surface with small covering setae and several, small, thin setae, including 2 primary setae basally and subventrally; tuft of long anterior surface setae characteristic for coxa of Amphipsyche and Macronema absent in Ae. rossica; small, mainly spinelike, light setae on posterior surface; several of them thin and longer. Dense, pointed, small, light spinules ventrally and posteriorly; a group of light setae, of which 2 yellowish (primary) setae are longer and slightly thicker than others, near margin distally and ventrally.

Anterior part of base of trochanter with a thin, light, subdorsal seta; 2 or 3 short setae situated subventrally near suture; ventral side with 4 long, brown setae; distal part with a short, light, primary, anterior seta; ventral side (mainly anteriorly) with long, brownish setae and several, thinner, light setae; distoventral seta in form of a short, blunt, brown spine.

Femur with convex dorsal surface and slightly concave ventral surface. Sparse short or long setae dorsally, a primary basal seta among them; distodorsal, primary seta brownish; small, light setae near it; a row of 21 or 22 long, brown setae on anterior surface, 7 or 8 distal setae shorter than others; anterior surface with isolated, thin, short setae basally and subventrally. A row of 4 long, thin, brown setae in middle of posterior surface. Ventral side with long, brown setae which are sparse in the distal part; several light, thin, less long setae among them. Unlike in Macronema radiatum, fore trochanter and fore femur of Ae. rossica without ventral spinules.

Tibia with a dense brush of thin, light, long, hairlike setae dorsally, subdorsally on anterior surface and on greater part of posterior surface, except near to base; anterior surface with several, thin, short setae; basal part with 3 or 4 long yellowish setae; ventral side with dense, light, strong, long spines in apical part.

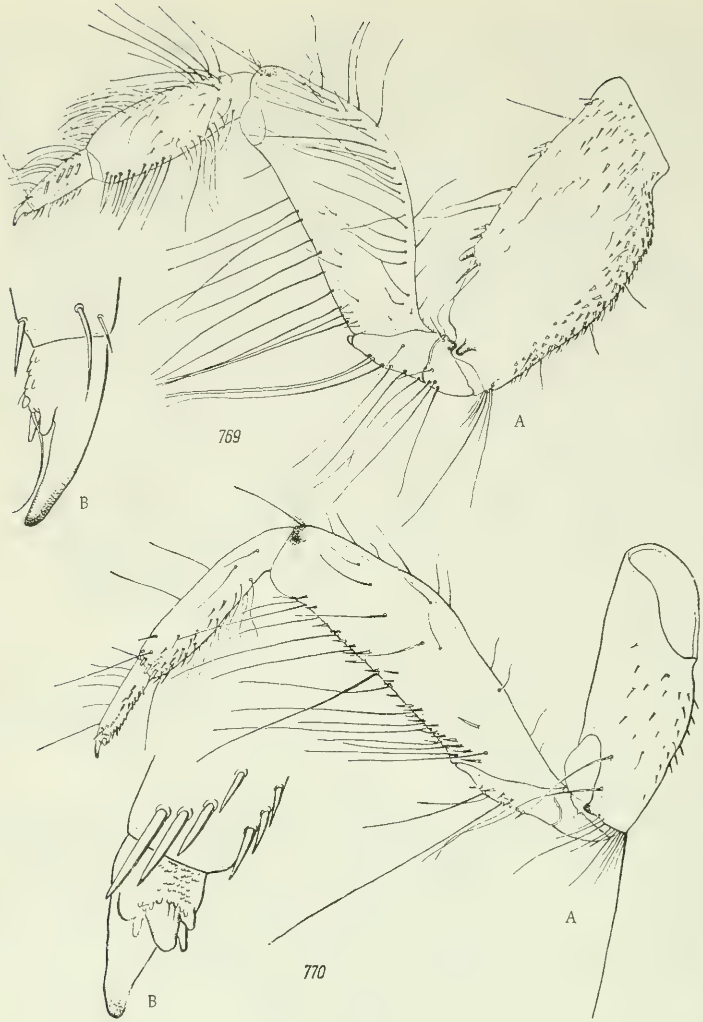
Tarsus tapering apically; thin, light setae dorsally and subdorsally; these setae are a continuation of dorsal brush of tibia, but are shorter and sparser; posterior part a yellowish, thin, relatively large primary seta distally and dorsally; 4 large, blunt spines anteriorly; a short, subdorsal seta (primary?) distally; 2 short setae subventrally in middle; subventral side with longer setae near apex on posterior surface; ventral side with 6 thick, light, pointed spines and a thin seta; a small, light, needle-shaped seta distally; a very small, dark spinule near it.

If legs are extended, their setae form a dense brush before head.

Claw massive, almost straight; 2 blunt, spinelike ventral processes at base; anterior process smaller than posterior process; a transparent
546 light primary seta adpressed to claw between them; small spinules laterally and ventrally near base of claw.

Mid-tarsus (Figure 770) dorsoanteriorly with a short, thin, primary, basal seta; primary distodorsal seta brown, long; a row of small, thick, light, spinelike, secondary setae among primary setae at anterior margin; posterior distodorsal seta thin, brown, situated near depression; a long, thin seta and 2 small, secondary setae more basally; anterior surface with
547 small, sparse, covering chetae; several larger sparse setae subventrally; distal margin ventrally, posteriorly and anteriorly with long setae, one of them larger than others.

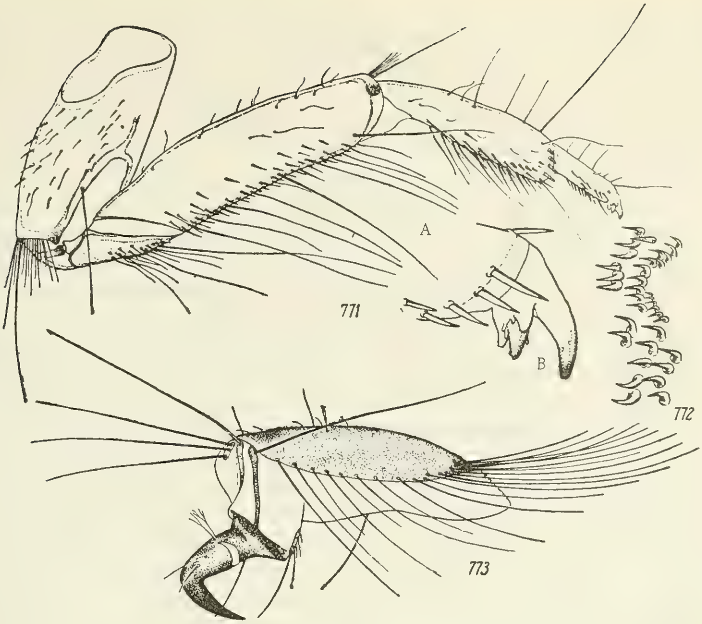
Basal part of trochanter with a strong dorsal setule; no long ventral setae in this part; long ventral setae less numerous in apical part than on forelegs, one of them very long; blunt apical spine absent.



FIGURES 769 and 770. Aethaloptera rossica Mart.:

769 – right foreleg, anterior (A), apex of tarsus and claw (B); 770 – left midleg, posterior (A), apex of tarsus and claw, ventral and slightly lateral (B).

Dorsal surface of femur less convex than on forelegs; ventral surface straight. Dorsal and subdorsal setae, including distodorsal seta, shorter and thinner than on forelegs; sparse, short, thin setae subventrally on anterior surface; distal seta larger than others (anterior primary seta?) posterior surface with sparse, thin, short setae, two of them long; primary posterior seta situated subapically near ventral margin, brown and long; subventral side with short, spinelike setae and spinelike chetae among long setae ventrally and posteriorly; there are also thin, short, hairlike chetae; long ventral setae shorter and sparser in apical part.



FIGURES 771–773. Aethaloptera rossica Mart.:

771 – right hind leg, posterior (A); apex of tarsus and claw, lateral (B); 772 – dorsal spinules of abdominal segment 2; 773 – right anal leg, lateral.

Tibia longer and narrower than on forelegs, without a dorsal brush of hairlike setae, but with sparse, longer and short setae; the distodorsal, posterior, primary seta among them; anterior and posterior surface with sparse setae; posterior surface subapically with a posterior primary seta; distal margin with 4 (sometimes 3) blunt, dark spinules including 2 small spinules. Ventral side with a row of large, light spinelike setae which are longer in basal part; a long, strong, light primary seta, ventrally and distally.

Tarsus straight, uniformly broad, much narrower than tibia; dorsal and ventral margin parallel; short and moderately long setae on dorsal side; primary distodorsal seta shorter than tibia; a light, short spine anteriorly.
548 Four similar large spines anteriorly near the apex, 2 of them situated subdorsally pointed and thinner than the other 2; surface with 3 or 4 thin small setae. Three pointed spines form an oblique row in subventral region posteriorly and distally, the dorsal spine larger than other 2; there are 1 or 2 small spines near this row; 2 rows of 11 or 12 pointed, thin spines ventrally; a light curved spinelike seta situated ventrally, and distally.

Claw shorter and more massive than on forelegs; pretarsus as long as basal part; 3 processes at the base of the claw, a light pointed median process and 2 lateral, blunt, brown processes; posterior processes shorter than anterior process; a blunt light spine between lateral processes, near base of claw; ventral side and sides near processes with small spinules.

Differences between hind legs (Figure 771, A) and midlegs small. Hind legs slightly paler, coxae shorter, anterodorsal setae thinner and smaller; femur less convex dorsally; dorsal setae smaller and sparser, long ventral setae less numerous; claw (Figure 771, B) blunt, narrower apically; basal seta and processes near base less massive than on midlegs.

Abdomen of fixed specimens yellowish white; segments 3—6 uniformly broad; segments 1—2 and 7—8 slightly narrower. Segment 9 very short and narrow. Integument smooth; covering chetae sparse, hairlike, small. Dorsum of segments 1 and 2 convex, with grayish, narrow transverse elliptical figures, which are densely covered with small hooked covering spinules; these spinules form groups and are directed posteriorly.

Primary anterior-margin dorsal setae small, light, thin, slightly larger on segments 5—7 than on other segments; anterior-angle seta brownish, small on segments 1 and 2, situated slightly anterior to elliptical figure on segment 1, opposite ends of elliptical figure on segment 2; anterior-angle seta on segments 3—7 brown, relatively large, slightly smaller than medioanal seta, and situated in about the middle of segment; medioanal seta brown, moderately thick, the best marked seta of dorsum; setae of both sides relatively widely separated; posterior to elliptical figure on segments 1 and 2, in the posterior half of sclerite on segments 3 and 7; several very small, straight, light, secondary setae near the medioanal seta; intermediate and lateral primary setae not distinguishable from other setae. Medioanal and anterior-angle setae of segment 8 displaced toward each other in anterior half, groups of posteriorly-directed, long, golden brown setae in posterior half, on tubercles on sides; ventral side of segment 8 with a small brownish sclerite on each side; 2 golden brown setae, one longer and thicker than other near posterior margin of these sclerites.

Gills forming 2 pleural and 2 ventral rows; pleural gills present on segments 2—7; upper pleural gills situated postsegmentally consisting of 1 branch; lower pleural gills situated presegmentally, with 2 branches; medioventral gills with 1 branch situated in middle of segment on segments 1—6; outer ventral gills situated more posteriorly; they have 2 branches on segments 1—4, 1 branch on segments 5—7; number of gill filaments and arrangement of gills given in Table 30.

TABLE 30

| Segment | Pleural | | Ventral | |
|---|---|---|---|---|
| | upper | lower | lateral | median |
| Mesothorax | – | – | 13 | – |
| Metathorax | – | – | 16 | 12 |
| 1 | – | – | 12+13 | 18 |
| 2 | 14 | 14+16 | 20+15 | 17 |
| 3 | 20 | 21+22 | 20+19 | 15 |
| 4 | 18 | 21+18 | 23+20 | 14 |
| 5 | 13 | 16+21 | 15 | 14 |
| 6 | 19 | 21+20 | 21 | 11 |
| 7 | 12 | 16+18 | 22 | – |

Anterior-margin setae of segment 9 small; anterior-angle and medio-anal setae situated close together, strong, relatively long, situated posterior
549 to small, brownish sclerite on sides of segment; between them a short, thin, brown, intermediate setae and a hairlike lateral seta. Numerous long, strong, golden brown, secondary setae at sides, which are thicker and darker than on segment 8. Sides ventrally with oblong (not triangular) yellowish plates; anterior part of these plates with dense, short setae; setae have a broad, reddish brown base and a long, light end; posterior part of plates with dense, reddish brown, long, strong setae.

Anal legs longer than in Amphipsyche; dorsal sclerite of section "b" (Figure 773) brownish yellow, with narrow, reddish brown dorsal and basal margin; ventral margin pale; articular rods reddish brown, with long, thin, brown, dorsal setae near base; membrane with 3 similar long, thinner, brown setae, which are analogous to anal fan of Hydropsyche; outer side distally and ventrally with a row of long chestnut brown setae at margin of sclerite which are sparser apically and dense basally; they number 34—38; there is a longitudinal group of 25—26 similar setae in middle; several setae near base of anal leg; sparse short setae at dorsal margin and on surface; membrane near sclerite "c" with a strong, long, brown seta ventrally; 3 or 4 short, thin setae further basally. Sclerite "c" brown, its primary seta strong, reddish brown and situated distally; 3 or 4 much smaller secondary setae near margin.

Dorsal setae 1 and 2 of the claw light and divided; seta 1 with 6 branches, seta 2 with 2 branches; median seta 3 brown, moderately long; outer seta 6 shorter; seta 8 straight, strong, light, reaching end of claw; seta 7 small, situated further basally, sometimes absent.

Mode of life and habitats. Large rivers, Ob, Yenisei, Amur, Ussuri and some lakes connected with rivers (Klyuchareva, 1952:363, 364, 372, 373). Large numbers of adults fly near rivers in summer.

Distribution. Western and Eastern Siberia, Amur and Maritime Territory in the USSR. In addition, West China.

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